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Don't Give Up The Ships

AT about the same time that Captain Lawrence gave his famous command "Don't give up the ship" a certain general whose name is best forgotten gave the following order to the American army defending the city of Washington: "If you retreat, go by the way of Georgetown." Needless to say the army went that way allowing the British that entered the city to disgrace themselves by burning our public records and buildings.

In those days we were a maritime nation; we had more sailors on our ships than we had soldiers in the army, and every sailor was well aware when he entered an engagement that it was a case of victory, surrender or death. Did Commodore Perry have any thought of giving up when his flagship was sinking? No, not so long as a rowboat was available to take him to another vessel and to one of the most glorious naval achievements ever accomplished.

Strange as it may seem we are now in the midst of a fight upon the result of which depends the very existence of our commercial and naval power. Ignoring the teachings of all history, that a non-maritime nation cannot maintain its place, even a number of those engaged in the shipping industry are accepting what one of our esteemed contemporaries aptly calls "defeatist propaganda" and are preparing gracefully to retreat along the road of continued Government ownership.

Under Government ownership only 386 vessels out of a total of 1,379 are in operation and thus it is costing the taxpayers $50,000,000 annually to keep a ratio of about one in four of its vessels working. Some of our senators seem to believe that it is more desirable to keep up this tragic situation rather than allow a subsidy of from fifteen to thirty millions for the purpose of interesting private capital in taking over these ships and operating them on sound business principles.

Now is the time for every man engaged in the maritime industry to write to his senator and to let it be known to all his associates that no constructive alternative to the Administration's shipping bill has yet been proposed. Practically all of our senators want to see our merchant marine developed. They are open to argument and example and, if this is not forthcoming from shipping men, who will furnish it? Watchful waiting may be advisable in some matters but a "we have just begun to fight" policy is more in accord with our marine traditions and certainly more likely to secure the respect of our senators. As Congressman Scott of Michigan recently said, "Two things are required to secure legislation, necessity and demand." The necessity for an adequate merchant marine exists but the demand is not strong enough.

The Navy Needs Ships and Men

THE Navy needs to have a number of its capital ships modernized, it needs fast scout cruisers of the 10,000-ton type permitted by the Disarmament Conference, it needs destroyer leaders and it needs aeroplane carriers. If the people of this country are not to be deceived about the relative strength of the Navy, a constructive program should be started at once, for the 5-5-3 ratio under present conditions is nothing less than a joke.

We not only need more ships to balance the fleet as compared with other powerful navies, but we need more men. Congress allows a personnel of only 86,000 men as compared with England's 120,000. Our enlistment period is only four years as compared with twelve years in England. Our enlisted personnel is largely composed of boys who serve only one term, whereas men who have spent twelve years at sea usually remain. Almost every trade is represented on a capital ship, and the majority of the crew of these complex fighting machines should be skilled mechanics. Is it not a terrible responsibility for this country to allow a condition to arise where it might be necessary to send these ships into

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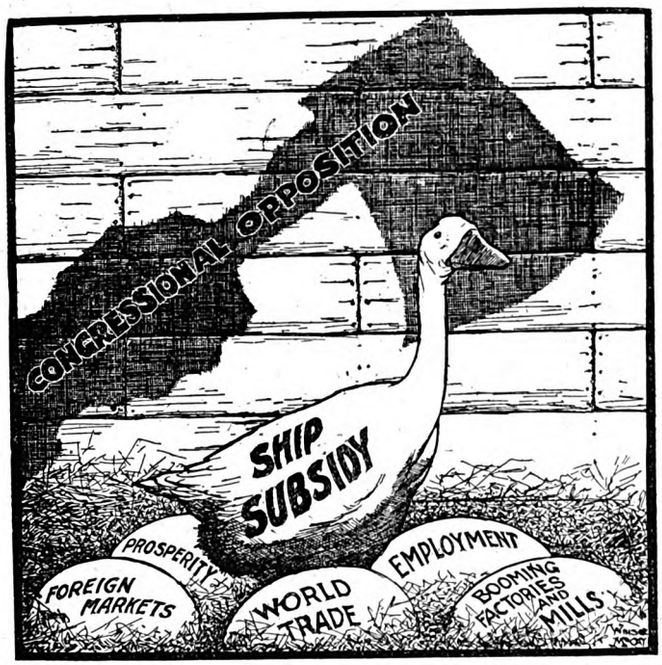
battle manned by untrained men? After agreeing to scrap over $300,000,000 worth of capital ships and fixing on a definite naval strength, why not live up to it? Other countries will never sign on the dotted line again if we don't.

Immigration Should Be Selective

INDICATIONS that there will be a shortage of labor in our large industries have awakened discussion on the possibility of revising our immigration laws. The present law limits the number of aliens that may enter this country in any one year to three percent of the number of their fellow countrymen that resided here at a particular time.

As is well known, this law has worked severe hardships not only on the steamship companies but also on the immigrants themselves and has led to a condition where a few hours' difference in the time of arrival of a vessel is often the determining factor of admittance. Would it not be of far greater advantage to us to place a limitation on the quality rather than number of immigrants? Is it not the anarchist rather than the producer which we desire to exclude or have we reached the limit of the industrial expansion that has made this country great? We believe that there is still room for the class of foreigners who will make good citizens and that the cooperation of the steamship companies would be gladly offered to secure such results.



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The Goose With the Golden Eggs

—McCay in the *New York American.*

The Red Star Line, for instance, has been in business for fifty years, its agents go into every country and they know all races and every grade of society. In other words this company must know exactly who they are forwarding and further they have every means of testing the mental and physical condition of their prospective passengers at the port of embarkation. This and many other companies could easily meet any requirements as to character or mentality that we specify. Canada is basing its immigration regulations on the selective system and we would find it both practical and advantageous to follow her example.

The Passing of the Minnesota

THE *Minnesota,* the largest merchant ship ever constructed in an American shipyard, the largest vessel in deadweight carrying capacity afloat today (22,500 deadweight tons) and, at the time her keel was laid in 1901, the largest vessel either built or building in the world, is to be broken up on account of her age and lack of ability to make an economical speed. The passing of this vessel ought to be a great object lesson to every American, for when James J. Hill built the *Minnesota* and her sister ship, the *Dakota,* he probably firmly believed that the country would enact legislation granting a reasonable subsidy to American ships.

Although several attempts were made to secure Government aid at that time, they all failed but the last bill was defeated in the House of Representatives by a margin of only 3 votes. Not only this, Mr. Hill was prevented in many other ways from making these vessels a financial success in the Seattle-Orient trade. Their splendid passenger accommodations and their enormous cargo carrying capacity should have been of great value to the Great Northern Railway and the producers of the whole country, but the Interstate Commerce Commission would not allow an export rate over the railroads that would permit a fair return to the steamship line. To cite a specific instance, Mr. Hill planned to take cotton from Louisiana by rail to Seattle and then ship it to the Orient. He could have done this successfully but the Government would not allow him to charge less for the rail rate to Seattle than the domestic rate to an intermediate point.

It is well known that both Messrs. Harriman and Hill were deeply interested in promoting American steamship lines on the Pacific and it is a great tribute to Mr. Hill's vision that he started to build, over twenty years ago, practically the type of combination cargo and passenger ships that have been adopted in the post war designs of the leading English steamship companies. In fact except in the matter of speed he is still in the lead; for with the exception of a few giant passenger liners in the North Atlantic service it is recognized that the combined passenger and freight vessel is the most economical type today. Compare one of the latest Cunarders, the *Scythia,* with her gross tonnage of 18,500 and her speed of 17 knots, with the *Minnesota* whose gross tonnage is 20,602 and her designed speed 14 knots.

What a shame that the foresight of this great man was not backed up by the Goverenment; for, if he had received any encouragement, he and others would have built more vessels and we would not have been caught in anywhere near so badly an unprepared state when the war came.

However, the past is past, we still have men of broad vision and we also have a wonderful example of what can be done by the coordination of a great railroad and steamship line. If the Canadian Pacific Railroad can operate a splendid steamship service on both the Atlantic and Pacific in connection with their railway system, why cannot we follow their

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lead? By no means the least important provision in the pending shipping bill is the clause permitting the intimate cooperation of rail and water transportation. The responsibility for the future is now squarely up to the United States Senate.

Cooperation Along Atlantic Seaboard Proposed

THE New York Board of Trade and Transportation has appointed a special committee of which W. T. Donnelly is chairman for the purpose of bringing into existence a clearing house in New York for trade and transportation problems of the Atlantic Coast states. Mr. Donnelly has cruised along the seaboard in his yacht from Maine to Florida and has talked to the business men and commercial bodies in most of the seaports.

As a result of this investigation he has found that every city has its transportation problems and that they are fundamentally of the same general character. The larger and unsolved problems of these seaports are of such a nature that they can only be properly handled by a central committee of able engineers whose services can be most easily obtained in a central location like New York.

While some of the people in the Southern seaports are more or less inclined to look at any project coming from New York City with suspicion nevertheless the fact that engineering skill and transportation of their agricultural products by water highways would create a market for their fruit and vegetables such as we are now importing from South America is bound to receive favorable consideration.

Great areas of the most fertile land in the country now lie under water in these areas and they can be reclaimed so that they will produce foodstuffs cheaper and in closer proximity to cheap transportation than any other section. In fact, there is an opportunity to repeat exactly what has been done in Holland which has furnished England with cheap produce for over three hundred years.

Standardization of German Shipbuilding

THROUGH the courtesy of the Transportation Division of the Department of Commerce we are able to publish the following report of the American Consul at Hamburg, Germany, relating to the progress made in the standardization of ship parts in that country.

"Standardization of German shipbuilding began in November, 1916, when the late marine engineer Veith called a meeting with a view to establishing a Marine Standardization Commission (Marine Normen Commission). This meeting took place on November 18, 1916, at the Germania Wharf, Kiel, and was attended by the representatives of the German Navy and merchant marine. Sittings were held periodically until the end of the war, when they were discontinued.

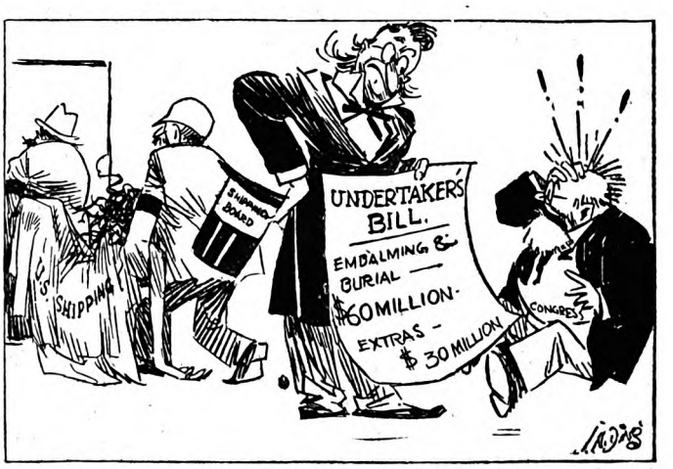
"The success which attended the work of this commission was an inducement to establish a similar organization to take care of the present day German merchant marine shipbuilders. This commission, known as the Handels Normen Ausschuss, is composed of representatives of five of the most important shipping companies and by the representatives of ten of the largest shipyards.

"Up to the present time a total of 1,026 standard parts has been passed by the commission and a number of ships have been provided with parts manufactured according to its standards.

"Quite recently, the Handels Normen Ausschuss, which followed the work of the Marine Normen Commission, had

FOR 25 MILLION WE COULD SEND HER TO THE SHIP SUBSIDY HOSPITAL WHERE SHE COULD BE CURED AND MADE SELF SUPPORTING.
CANTAFFORD IT. LET HER GO ON AND DIE IF SHE WANTS TO
CONGRESS
U.S. SHIPPING

Looks like a lot of money to pay for medicine—



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But it isn't half as much as the undertaker will charge

Cheaper to Pay the Doctor Than the Undertaker

—Darling in the *New York Tribune.*

an exhibition in the Charlottenburg Academy showing a collection of parts which were manufactured according to the new marine standards. About 50 firms from all parts of Germany sent exhibits.

"This is the beginning of a new epoch in shipbuilding which all countries having a merchant marine may advantageously adopt, thus greatly facilitating the building and operating of ships. This is an extremely favorable economic procedure which railroad companies have long since followed and which has proved so beneficial that it is to be wondered at that the standardization of parts for ships did not spread to the shipbuilding industry in all countries a long time ago."

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East Versus West on the Shipping Question

Lack of Understanding of Natural Significance of American Merchant Marine Shown in Arguments of Opponents to Subsidy Bill

By C. A. McAllister

THE writer recently published an article on the "A B C of the National Shipping Bill," in this magazine, which was subsequently reprinted in pamphlet form and given wide circulation. A copy of this was forwarded to a banking friend in Chicago, which brought forth the following reply:

"Chicago, Ill., December 20, 1922.

"My dear Captain:

"I acknowledge receipt of a repriht of your article recently published in MARINE ENGINEERING AND SHIPPING AGE entitled 'A B C of the National Shipping Bill.'

"I have read this with much interest and I congratulate you on the simple and able way in which you present this subject from your viewpoint, even though I fear I cannot agree with all of your arguments and certainly not with all of your conclusions.

"Many of us in the West, including the writer, are opposed to a national subsidy to promote American shipping, believing that this is wasteful and uneconomic in principle. I think that our opposition is chiefly based on the theory that if foreign ships can and will carry our products cheaper than we can carry them, we should permit them to do so and that there is no good reason why we should spend public money to foster an enterprise which can be more economically handled in, by or through other countries. In other words, if a United States marine can handle shipping as cheaply as foreign vessels, then there is no need for a subsidy and if they cannot handle the business as cheap as foreign vessels, it is wasteful and uneconomical in principle to attempt to engage in that line of business.

"Personally, I see no particular advantage to a United States merchant marine and we have gotten along pretty well for a good many years without anything of that kind worth speaking of. So far as future wars are concerned, it seems highly improbable that there can be any important war for many years to come, owing to the terrific exhaustion of a large part of the civilized world in the recent conflict. Moreover, it seems to me altogether probable that if there should be another great conflict in the distant future, fighting apparatus would be so changed that a merchant marine on present-day lines would be of little or no practical use.

"Your argument intimates that ship subsidies will probably be unnecessary after 10 years. I disagree on this point and believe that a subsidy will always have to be paid in order to maintain a United States merchant marine. We had a considerable merchant marine, something like a hundred years ago, without any subsidies whatever and this instead of growing, developing and increasing, gradually disappeared under adverse economic influences which still exist. These adverse influences would operate in the same way now to prevent any American merchant marine from being self-supporting, and, if subsidies were discontinued at the end of 10 years, the American merchant ships would again disappear from the ocean. The whole question seems to me to be an unwise attempt to spend the public money in defiance of economic laws.

"Referring particularly to your argument respecting the way in which the building of American ships will benefit labor, I should think it were quite apparent that we haven't sufficient labor in the country now and that there is no occasion for diverting one hundred thousand able-bodied American laboring men from other useful and productive enterprises into the unproductive shipbuilding business. So far as the American farmer is concerned, these men will have to be fed in any event, whether they are engaged in shipping, building or in the steel industry and the connection of their employment could have no effect on the prices of farm products.

"If a United States merchant marine cannot stand on its own foundation it ought not to exist. To support it by special subsidy is merely to waste public money which has to be raised by taxation and additional burdens in other enterprises. We have already wasted a great deal too much.

"Cordially yours,

"L ———."

The above letter represents the opinion of a number of our prominent business men in the Middle West but the fallacy of such arguments is apparent to those who understand the importance of an American merchant marine as shown by the following reply:

My dear L.:

I have your very frank criticisms of my views on shipping legislation, and am indeed glad to receive them, as they represent in very straight-out terms a sentiment confined largely to the Middle West, but which has been, thus far, sufficiently potent to delay action on this very important bill.

OPINIONS INFLUENCED BY GEOGRAPHIC ENVIRONMENTS

In a vast country like ours differences of opinions on great economic subjects such as this, are bound to obtain, influenced largely, I think, by geographic environments, which cause us to view this and kindred subjects from entirely different viewpoints. Indeed so antipodean are the opinions of Americans on many of our economic problems that it is quite remarkable that there is concert of action on more than the most elementary principles of self-government. It probably is due solely to the underlying American trait of fairness that, as a nation, we have gotten together after full and free discussions and enacted many of our laws for the general good. That we have prospered far beyond the most sanguine dreams of the founders of the Republic, must be taken as evidence that most of our laws have been beneficial.

In making the following replies to the several criticisms which you have made, I do so merely to point out wherein our differences of viewpoints lead us, and their direct bearing on the prosperous conditions which this country has developed.

Your statement that "I think that our opposition is chiefly based on the theory that if foreign ships can and will carry our products cheaper than we can carry them, we should permit them to do so," and that "there is no good reason why we should spend Public money to foster an enterprise which can be more economically handled in, through or by other countries" is one that is really the heart of the entire controversy between East and West.

FALLACY OF ALLOWING FOREIGN SHIPS TO CARRY OUR PRODUCTS BECAUSE THEY CAN DO IT CHEAPER

This argument is certainly not new as it has been raised against every new industry in which this country has ever embarked. Fortunately for all concerned it has but seldom prevailed.

If it had been carried out logically from the beginning

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of our national life, we would today be a nation of producers of raw materials, with just sufficient mercantile and banking interests to carry on the exchange of these raw materials for the manufactured articles of Europe. For example iron and steel are the great basic materials on which our predominance as a manufacturing country depends. In the early days we could not produce iron or steel goods of as good quality or anywhere nearly so cheaply as we could purchase them abroad and have them delivered at our very doors. Our English cousins were quite willing and anxious to make all our iron products for us, and even went so far as to tell us that it was "wasteful and uneconomic" for us to embark in that enterprise which they could do for us so much cheaper.

THE CASE OF TEXTILES

In the great cotton industry they welcomed the raw product, which the fertile soil of our Southland produced so lavishly, but our early New Englanders, while familiar with spinning jennies, should never go into the manufacture of textiles because the mills of Manchester could do it so much better and cheaper than they.

In our own generation we have seen the great advances made in the manufacture of woolens in this country. Why should we have ventured into that industry at all? English mills made splendid cloth, and sold it to us much cheaper than we could produce it here. We also have seen the rise of the tinware industry in this country. As boys we remember when all such was imported from Great Britain. Why should we not have continued to buy it abroad? They made it cheaper than we could here, and cheaper even now than we can make it. Apply the same reasoning to any one of our great manufacturing industries in this country and you will find that almost without exception none has been built up without being fostered by our Government through the medium of the protective tariff.

SUBSIDY SERVES AS PROTECTIVE TARIFF

Now this proposed payment to shipowners, popularly known as a "subsidy," is nothing more nor less than a protective tariff to shipping; as it is the only industry in this country today which does not have protection of some sort why single out this oldest of all industries, as the only one which must alone and unaided wrestle with our old friend "economic conditions"?

So much for the fairness of the proposition, let us now look at the subject as a matter of self interest to the nation, and consider your statement that "I see no particular advantage to a United States merchant marine."

Your great city of Chicago has been built up from a trading post where the farmers of the vicinity swapped their raw materials for the clothing, furniture, hardware, etc., necessary for their existence, which had been brought by ships from European manufacturers, into one of the greatest manufacturing centers of the world, largely through the benefits of the protective tariff, and through its contiguity to the products of farm and mine. You are prosperous just now, because the United States is prosperous and consumes the bulk of your manufactured output, the remainder going to devastated countries in Europe, where the demand is strong and the buying power weak. If the home markets could take all your output, all well and good, as your only need for shipping would then be the modern prairie schooner running on steel rails.

But Germany and Russia are not going to remain out of the economic picture all the time, and when they get back to producing and trading, Chicago and the Middle West will not find such easy world markets for their excess products of the farm and factory. Germany showed quite conclusively that by her cheap manufacturing and owning her own merchant ships she was very rapidly assuming mastery of the world's commerce, before her militaristic leaders led her into national hara-kiri. Her commercial supremacy was, as every one knows, built up almost coincidentally with and principally due to the upbuilding of her merchant marine.

COMPETITION IN FOREIGN MARKETS

When world conditions grow normal, as they must, we will have at least a surplusage of fifteen percent of farm and manufactured products, which we will have to sell in competitive markets abroad. In spite of your dictum that the ship which will carry our exports the cheapest should get the business, you know full well that the oft pronounced adage that "you cannot sell your products from the other fellow's delivery wagons," applies just as forcibly to our world trade, as it does to small town rivals in merchandise. Human nature prevails throughout all our undertakings, no matter on how large a scale transacted. You cannot expect an English or a German ship to carry goods manufactured in Chicago to a competitive market in South America for example, and not give preference in the many ways known to ship operators, to similar goods manufactured in their own countries which are in the competition. To illustrate, I must quote an incident which actually occurred in one of the leading ports of South America.

A large railroad contemplated the purchase of thirty locomotives, and invited bids from builders in the United States, England and France. An English attaché of the consulate, and they are always on the alert, persuaded the purchasers to change the proposals from f. o. b. nearest seaport to c. i. f. The bids when received were so close between American and British builders, that the decision was made on the difference in the cost of the freight. It happened that the same British steamship line served both Liverpool and New York from this South American port, and, although New York was actually 500 miles nearer the point of destination, the American locomotive builders were quoted higher rates than the English builders. This resulted in a contract involving over half a million dollars being given to Great Britain instead of to us. Oh! yes! Let the "cheapest" carrier do our business for us.

Again, it is a well known fact that British ships carrying our cotton to their own ports have actually carried their manufactured articles on the return trips to what should be our natural market, ports in the West Indies, at a lower rate, than they could be carried in "foreign ships" from Boston and New York. How could they do that, I hear you ask? Very simple, they "stung" our Southern cotton growers a sufficient excess in freight on their home-bound voyages to make the round trip profitable. Yet the Southern representatives in Congress are joining you people in the Middle West in damning anything which helps an American merchant marine.

Once more, "let the cheapest carrier do our business."

IMPORTANCE OF A MERCHANT MARINE TO THE NATION

In the arguments which you and the other opponents of American shipping put up, you overlook the great underlying fact that a merchant marine must be national, just as much as the Army and Navy. There are certain functions in life, which we as individuals, families, cities, states or as a nation must do for ourselves; things which we cannot hire done by others, even though performed cheaper. Now I haven't a doubt in the world but what we could replace all the officers and men in our Army and Navy by officers and men from Germany or Japan, and have both these great services run "cheaper" than they are now. I also have no doubt, but that the city of Chicago could go out to India for example, and employ big, lunky natives to serve you as policemen and firemen, for less than half the present cost to Chicago taxpayers of your present efficient forces.

On your principle of having the merchant marine "more

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economically handled in, by or through other countries," just begin at home by applying that principle in the direction I have suggested, and see what would happen. The "economy" would be there, but, Oh Boy, what a ruction would be raised! You see these grand and glittering economic generalities do not work so well, when generally applied. Therefore, to use the language of the day "Why pick on us?" Why pick on an industry which has built up all the great nations in history, because shipping is most decidedly a *national* institution.

UNJUSTIFIED OPTIMISM

Referring to your optimism regarding the improbability of any important war for many years to come, and hence no necessity of a merchant marine for military purposes, I must say that I devotedly join with you in your *hopes* along that line. Just as I am writing this, however, I note that a vast French army is marching into Germany. Evidently the dove of peace in that locality is getting his, her or its feathers scorched.

It was just such optimism as you express, and which was enunciated by millions of our countrymen, which led us to neglect our merchant marine for over half a century. The net result is that you and I and all our fellow long suffering taxpayers will be digging down in our threadbare jeans for the next fifty years or more, to pay our portion of the annual interest on about three billions of Liberty Bonds, being the amount we very feverishly expended to build up our merchant marine in two years' time, to meet the conditions thrust upon us in a World War, which optimists thought would never come upon us.

I am just as far from being a militarist as are you, and I cannot conceive of anything being more wasteful, uneconomical and suicidal than this continued wrangling between nations, with resultant squandering of money for military purposes. But I am old enough to have observed that human characteristics have not changed appreciably in my lifetime, and show no evidences of even changing for the better. So long as individuals will quarrel and fight, what can we expect of nations composed of individuals possessing and governed by fundamental human traits. Under such conditions the best we can do is to prepare for the worst that can happen, and feel quite sure that our very preparedness will do more to obviate armed conflict than any other precautions we can take.

MERCHANT SHIPS WILL BE NEEDED FOR FUTURE WARFARE

As to your surmise that future warfare, if it should occur, would be conducted with such new apparatus as to preclude the use of a merchant marine, let me suggest that mankind has not yet mastered the art of walking on the water to any considerable extent. If the scene of future hostilities is transferred to the air, as I firmly believe will happen, supplies and men will still have to be transported over the seas in merchant ships and transports. I cannot conceive of any kind of warfare being carried on, where the use of ships on the surface of the seas will not be necessary. Ships capable of going to sea in all kinds of weather cannot be improvised nor purchased from other nations after hostilities have commenced. If we are again caught without sufficient merchant shipping as we were during the recent war, our penalties may be far greater than those from which we are now suffering, in the form of our great national debt. We too may be confronted with reparations in addition to our own debts, as it is quite conceivable that the next time we will not have self-interested allies to make up our deficiencies on the seas.

If you will read President Harding's able message on our present shipping status, it will be very plainly proven to you that the passage of the pending bill will actually decrease our present taxation instead of increasing it, as is popularly supposed by those who have given the subject only superficial study.

Thanking you for the attention you have given my brief on the subject, and the opportunity of making this reply, I am,

Cordially yours,
C. A. MCALLISTER.

Diesel-Engined Combination Lighter and Towboat Ordered

A CONTRACT has recently been awarded by the Cuban-American Sugar Company to the Vinyard Shipbuilding Company, Milford, Del., for a combination lighter and towboat, designed by Cox & Stevens, naval architects, New York, who will also superintend the construction of the vessel.

The boat, which will be equipped with a Diesel motor, is of wooden construction of the following dimensions:

Length overall	90 feet, 0 inches
Length on waterline	85 feet, 6 inches
Breadth molded	22 feet, 0 inches
Depth (top of keel to top of deck beam at side)	10 feet, 10 inches
Draft	8 feet, 0 inches

The boat is of the conventional lighter type, with machinery aft, derrick mast and boom at the forward end of the house, and a cargo hold forward, as well as stowage for deck freight. The scantlings of the hull are in accordance with best practice for vessels of this type. Particular attention has been paid to fastening the hull so as to secure rigid construction, the planking having square fastenings with two locust treenails and two galvanized iron spikes to each frame crossing.

Water tanks of galvanized iron construction of 500 gallons capacity are provided under the after deck, and fuel oil tanks of three tons capacity, lubricating oil tanks of 120 gallons capacity, as well as tankage for kerosene and gasoline are provided, all of steel construction except the gasoline tank which will be of copper.

The machinery equipment consists of the main engine of the Winton Diesel reversible type, to deliver 225 brake horsepower, with air compressor, fuel oil service and transfer pumps, and all the necessary equipment for complete installation. Electric lighting will be supplied by a 5 kilowatt Winton generator set, using kerosene as fuel. There will be a hoisting engine, oil engine driven. Steering will be by hand from the pilot house.

In the house on the main deck there will be forward of the machinery enclosure a double-bedded stateroom, on the port side of the engine room enclosure another stateroom with two berths, opposite which on the starboard side is a toilet and a stateroom. Aft of the machinery space and in the same house on the port side is a galley, fully equipped, and on the starboard side a mess room for the crew.

On top of the deckhouse between the funnel and the mast is a pilot house with a berth for the captain.

The after deck is left clear for towing purposes and is fitted with heavy towing bitts. A cargo winch is placed aft of the mast, the upper deck being carried over at this point to afford protection from the weather. The whole deck forward of the house is left clear for the stowage of cargo. Forward on the centerline is a heavy pair of bitts of the regular towboat type, and all the necessary and usual chocks and cleats and deck fittings are included in the specifications.

It is interesting to note that on this small craft it will be possible, even when water and fuel tanks are full, to carry approximately 100 tons of cargo. This would have been an impossibility on the given dimensions had steam machinery been employed for an equivalent steaming radius.

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Effect of Stevedoring Costs on Operating Expenses

By Lawrence B. Chapman*

Discussion based on theoretical ships, ideal trade conditions and certain assumed data showing what gains in profits may be expected by reduction in stevedoring rates and quicker turn-arounds.

TODAY a great deal of attention is being directed to the handicap of American ships because of the greater first costs and higher wages and subsistence costs of American crews. Fuel costs, engine-room economy and the advantages of the motorship are also receiving much attention. While all of these are important in the building up of an efficient merchant marine in competition with other nations, yet it is interesting to note that practically no attention is being directed at the problem of cargo handling and turn-around.

It is obvious to even the casual observer that most of the methods used today in handling cargo at American ports are very inefficient and slow. The problem of handling of ship's cargoes is intimately connected with the layout and operation of marine terminals and piers and one should not be studied without attention to the other. However, it is my intention to take up at this time only one phase of the problem, namely, the loading and unloading of the cargo at the ship.

Costs of Loading and Unloading Cargo

The costs of loading the cargo from the pier to the ship's hold and discharging the cargo from the ship to the pier rightly belong to the operating charges of the ship; while the handling of the cargo to and from the transit shed, sorting, tiering, etc., should be charged against the cargo and not against the ship.

To show the effect on operating expenses of cargo handling and turn-around the following example is given. This example assumes ideal conditions and speeds of cargo handling beyond present day practice. It is presented to illustrate how variations in the speed and cost of handling cargo affect the annual profits.

Main Particulars of Vessel

Length between perpendiculars.....420 feet
Beam .....60 feet
Draft .....26 feet
Depth .....35 feet, 6 inches
Displacement .....14,600 tons
Gross deadweight .....10,000 tons
Net cargo deadweight for 5,000 miles.....9,050 tons
Net tonnage 4,750
Sea Speed .....11½ knots
Shaft horsepower 2,980
Geared turbines; watertube boilers; fuel oil; cargo carried per voyage.....75 percent of net cargo deadweight
Initial cost of ship.....$1,000,000

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Table I gives the data and annual operating expenses for the above ship for four different conditions of cargo handling. The data for ship No. 1 is taken with a slight modification in fuel cost from an article by the author in the January issue of Marine Engineering and Shipping Age. The reader is referred to that issue for a full explanation and method of computing the data.

In computing the expenses shown in Table I it was assumed that 5 hatches were in operation for 10 hours per day and that each hatch was handling 30 tons of cargo per hour—a rate very much higher than the average today.

Rate of Stevedoring

Observations by the author at the Port of Boston over a period of two months covering a large number of ships with a great variety of cargo, brought out the fact that the average speed of handling cargo was about 20 tons per hatch per hour with about 25 tons per hour as a maximum. These observations also showed that in most cases only three hatches were being worked at one time. This would give a rate for the ten hour day of $20 \times 3 \times 10 = 600$ tons per day instead of 1,500 tons per day allowed in Table I for ship No. 1.

The writer has observed many cases where the rate has been as high as 32 tons per hatch per hour for short periods. In one case where sugar was being unloaded the rate averaged nearly 70 tons per hatch per hour for a long period.

The rates used in Table I have purposely been chosen in

Table I.—Data for Voyage of 5,000 Miles

		No. 1	No. 2	No. 3	No. 4
1.	Rate of stevedoring (tons per hatch per hour)	30	20	30	30
2.	Hatches being worked	5	3	5	5
3.	Rate of stevedoring per 10 hour day (tons)	1,500	750	1,500	1,500
4.	Cost of stevedoring per ton handled	$.70	$.70	$1.40	$.35
5.	Calculated days on the run + 5 percent	19	19	19	19
6.	Calculated days in port + 10 percent	10	20	10	10
7.	Days per single trip	29	39	29	29
8.	Single trips per year	11.53	8.60	11.53	11.53
9.	Tons carried per year at 75 percent capacity	78,300	58,300	78,300	78,300
	Annual expenses:				
10.	Depreciation (5 percent)	$50,000	$50,000	$50,000	$50,000
11.	Insurance on hull and machinery (5 percent)	50,000	50,000	50,000	50,000
12.	Repairs, maintenance and overhauling (5 percent)	50,000	50,000	50,000	50,000
13.	Fuel used at sea and in port at $1.25 per barrel	72,500	59,000	72,500	72,500
14.	Lubricating oil and fresh water	3,000	3,000	3,000	3,000
15.	Wages of crew	37,500	37,500	37,500	37,500
16.	Subsistence	8,500	8,500	8,500	8,500
17.	Tonnage dues and port charges	34,500	39,500	34,500	34,500
18.	Brokerage and management	39,000	29,000	39,000	39,000
19.	Stevedoring	110,000	81,500	220,000	55,000
20.	Annual operating expenses	455,000	408,000	565,000	400,000
21.	Receipts from cargo at $7.50 a ton	586,000	438,000	586,000	586,000
22.	Annual profit (Line 21—Line 20)	131,000	30,000	21,000	186,000
23.	Percent return on investment	13.1	3	2.1	18.6

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excess of rates used today to show the effect of quick turnarounds on profits and freight rates.

Anderson in his paper "The Most Suitable Sizes and Speeds for General Cargo Steamers" before the Institution of Naval Architects in 1918 proposed rates for a ship of this size of 36 tons per hatch per hour. He assumed 6 hatches in operation for 10 hours giving 2,160 tons per day as an ideal condition of cargo handling.

Basic Cost of Handling Cargo

The basic cost of handling cargo has been taken as 70 cents per ton and calculations have been carried through for rates of one-half and double this basic rate. Two rates of cargo handling are given, namely, 1,500 tons per day and 750 tons per day.

Table I shows the total annual operating expenses and profits for a freight rate of $7.50 per year for four different conditions. The data in this table bring out some interesting facts.

Days Spent in Port per Voyage

Line 6 shows the days spent in port per voyage discharging and receiving cargo. This time is directly affected by the rate of stevedoring. The result of reducing this rate for ship No. 2 doubles the number of days spent in port and reduces the number of trips per year. This in turn reduces the income from cargo (line 21) and the annual profit (line 23).

For ships Nos. 3 and 4, when the rate of handling cargo remains the same as for ship No. 1, the only item changed is the cost of stevedoring (line 19). The effect of this on the profits is shown in line 23.

The capital charges, which are 15 percent of the investment, continue whether the ship is in port or at sea. As the ship is built primarily to carry cargo between two points, its efficiency should be measured by the percentage of the total time that is spent at sea. For the ship in question, the capital charges amount to $410 per day. If the ship is idle, this item is a dead loss, for the ship is not earning profits while in port.

The calculated time in port for cargo handling has been increased 10 percent to allow for tides, holidays, etc., and the calculated time at sea has been increased 5 percent to allow for bad weather. Thirty days per year have been allowed for annual overhauling. The crew's wages are based on the Shipping Board's scale effective April, 1922. Fuel oil has been assumed at $1.25 per barrel and 8 pounds per gallon, lubricating oil at 75 cents a gallon and feed water at $1 a ton. Port fuel for heating, lighting and operating the winches is 7 tons per day. Port charges include tonnage dues, pilotage, towage, miscellaneous fees, cooperage, dunnage, watchmen's and clerks' wages and wharfage.

Variable Factors Affecting Stevedoring Costs

The data presented in the tables are for a voyage of 5,000 miles and the stevedoring costs naturally vary with the length of voyage. For this same ship on a voyage of 10,000 miles the number of trips per year becomes 7.15 and the cargo carried per year reduces to 43,000 tons. Thus on the long voyage the stevedoring costs are reduced because of the smaller number of tons handled per year. For ship No. 1 the stevedoring charges reduce from 24 to 15 percent of the total operating expenses for the 10,000 mile voyage.

Conversely, the shorter the voyage the greater are the relative charges for stevedoring, becoming an extremely large proportion of the operating expenses of the vessel on the very short route.

The cargo handling charges also change with the size of the ship but according to no definite law; hence an example should be worked up to give a reliable comparison.

Table II shows the above expenses arranged as percentages of the annual operating expenses. This table shows clearly the importance of the various annual expenses.

Capital charges, which are fixed by the first cost of the ship and the cost of repairs and overhauling, is the largest item, being about ⅓ of the total expense of operation.

Stevedoring of the cargo is the next largest item and averages about 1/5 of the annual outlay for operation.

Table II.—Operating Expenses Arranged as Percentages

	1	2	3	4
1. Capital charges	33.0	36.7	26.5	37.6
2. Fuel, lubricating oil and water	16.6	15.2	13.4	18.8
3. Brokerage and management	8.6	7.1	6.9	9.8
4. Crew and subsistence	10.0	11.3	8.1	11.5
5. Port charges	7.6	9.7	6.1	8.6
6. Stevedoring	24.2	20.0	39.0	13.7
Total operating expenses	100	100	100	100

Observations made by the writer lead him to believe that present day methods of cargo handling can be greatly improved upon. The most important factor of course is labor and at present the shipowner is more or less at the mercy of the stevedores. Yet, if the union stevedore can handle sugar at the rate of 70 tons per hatch per hour at 40 cents per ton, why should a shipowner pay $1.50 per ton for general cargo and tolerate a speed of 18 tons per hatch per hour?

The size of the draft today averages about ½ ton which is about the best that can be handled without becoming too bulky and unwieldy. The number of drafts per minute, however, is very low, averaging in most cases between 1½ to 2 minutes per draft. If a rate of 1 draft per minute could be maintained, the 30 ton rate per hatch would be possible and with 1⅓ drafts per minute 40 tons per hatch could be maintained.

Methods of Handling Cargo

The following systems and methods of handling cargo are in use today:

(1) Swinging boom (one boom, one winchman, one hook).
(2) Burtoning by yardarm method (2 booms, 1 or 2 winchmen, one hook).
(3) Burtoning with 2 hooks (2 booms, 2 winchmen, 2 hooks).
(4) Pier crane in combination with one ship boom.
(5) Conveyors.
(6) Conveyors in combination with any of the above.

Any of the above systems may be used in combination with the skid, if the marginal way between the ship and the pier shed is too narrow. For any of the systems to work efficiently, however, there should be a marginal way about 35 feet wide between the ship and the transit shed. The necessity for this will be clearly shown later on.

(1) The swinging boom, although still used to a considerable extent, is far too slow and antiquated to receive any consideration.

(2) In the burtoning system, where only one hook is used, one boom is stayed over the hatch and another over the ship's side. The draft of cargo makes a continuous movement from ship to pier. Generally two men are employed to operate the winches, one slacking off while the other hoists. Frequently one man can manipulate both winches, thereby saving the cost of one man. In the hands of skillful stevedores and with proper equipment, good speed can be maintained with this system.

Burtoning With Two Hoists Offers Best Possibilities

(3) The method of burtoning by the use of two hoists, however, offers the best possibilities for speed and efficiency. In this system one boom and hoist handles the cargo from the hold to the deck and the second from the deck to the pier or vice versa.

Today, the method of operating this latter system is often

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very inefficient. In unloading, the draft from the hold is frequently not placed on deck until the one previously placed there has been removed and the draft to the pier is held suspended until stevedores arrive to take it. Used in this way the system is very slow and the real advantages of it are lost.

Properly used the system should have two reservoir piles, one on deck and one on the pier so that delays at one hook will not cause a delay all along the line. Thus, if each hoist works independently of the other, several drafts will be accumulated on deck and several on the pier. With this arrangement any accident or delay at the hatch boom will not cause a delay at the wharf boom or among the stevedores on the pier. The accumulated drafts on deck will act as a reservoir supply for the wharf boom until the hatch boom is again in operation. Similarly, if an accident stops the wharf boom, the stevedores have a reservoir pile on the pier to draw from. By the use of this reservoir principle a continuous stream of cargo can be maintained from ship to pier or from pier to ship and, with a sufficient number of stevedores, between 30 and 40 tons per hatch can be maintained.

Ordinarily this system is much faster than the yardarm system, which uses one hook, because the reservoir principle is lacking with the latter. However, when uniform cargo carriers are used which can be placed directly on electric or trailer trucks and when there are plenty of trucks and carriers available so that there is absolutely no waiting for a draft in the hold or on the pier, the speed of this system can often be made equal to, if not better than, the two hook system.

(4) The pier crane while capable of handling heavy drafts is at a disadvantage because of its speed. Ordinarily a draft of much over a ton becomes too bulky to handle; so a crane of large capacity is of no advantage for general cargo. If used in conjunction with one ship's hook, the pier crane can handle two drafts at one swing. It is of particular advantage when handling cargo to or from an upper deck of a pier. However, the pier crane offers no advantage over ship's booms and except for two deck transit sheds or for special heavy pieces is not to be recommended.

Conveyors have not been used to much extent in handing cargoes to or from ships. For standard package cargo there is no reason why conveyors from ship to pier and conveyor hoists from hold to deck should not show better speed and labor costs much below any of the other systems.

WIDE MARGINAL WAY SHOULD BE PROVIDED

No matter which system is used a marginal way about 33 feet wide should be allowed between the ship and the transit shed. This allows plenty of space for the pier reservoir and results in much saving of time both in receiving and discharging cargo. Comparatively few American piers have this marginal way and hence the skid must be used which causes untold delay and confusion on the pier.

In stowing cargo the draft should be unfastened from the hook as soon as it has been placed in the hold. Frequently long delays take place in the hold because the hold gang attempt to stow each draft while it is still fast to the hoist. The hold gang and the pier gang should be of sufficient size to keep pace with the ship's tackle.

Although the foregoing discussion is based on theoretical ships, ideal trade conditions and certain assumed data, it shows clearly the gains in profits that may be expected by a reduction in stevedoring rates and quicker turn-arounds.

Steamship America Saves 1,400 Tons of Coal in Three Voyages

LAST fall, considerable comment was made in marine circles regarding the performance of the S.S. *America*, operated by the United States Lines for the United States Shipping Board.

This vessel had been selected by the Fuel Conservation Committee, which is composed of Captain C. A. McAllister, Commander R. D. Gatewood, Colonel George Bartlett, Major George M. Talbot, Maurice Healey, E. A. Peabody, D. M. Myers, H. B. Taylor, F. B. Webster, C. J. Jefferson, E. A. Stevens, C. H. Jack, as an example of what could be done to increase the efficiency of operation of some of the vessels of the American merchant marine. The port staff of the United States Lines and the engineer personnel of the vessel cooperated heartily in the program.

The results of the first voyage were made public and showed remarkable saving. However, there was considerable skepticism as to whether or not this saving would continue. On December 9, the *America* completed her third voyage since the furnace fittings had been modified and the total fuel savings for the three voyages now totals 1,400 tons, the vessel operating with the same speed and draft conditions as she had previous to the changes.

Fig. 1 shows the condition of the furnaces as they were previous to the changes. This is a typical installation used on all the double-ended boilers of the ex-German ships by the Germans. It will be noted that the combustion chamber has practically 30 percent of its volume cut out by the brick division wall and the long sloping brick bridge wall. The grate surface in this case was 6 feet 3 inches long and it was practically impossible for the firemen to work the rear end of the fires.

Fig. 2 shows the furnaces as they now are. The combustion chamber has been cleared of all brick work and now affords a reasonable volume in which the gases can complete their combustion. The grate bars have been shortened 9 inches so that the entire fire can be worked.

The cumbersome long sloping brick bridge walls have been replaced with a cast iron ventilated type of bridge wall which permits sufficient air to enter the rear end of the fire to complete combustion and to eliminate the troubles arising from large clinkers growing at the bridge wall.

By carrying out the principles of good fire room practice, that is, keeping the ash pits cleaned out and the opening between grate bars and between the sections of the bridge wall free of slag or ash, the operating personnel has kept this equipment in its original condition and no maintenance charges have been necessary up to date.

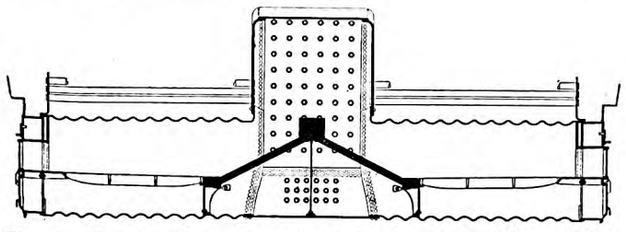

Fig. 1.—Former Arrangement of Grates and Bridge Walls as Installed by the Germans

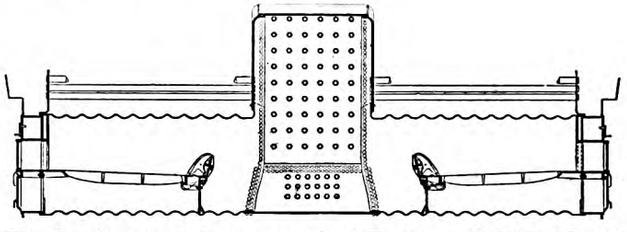

Fig. 2.—Improved Arrangement of Grates and Bridge Walls Made By Shipping Board Fuel Conservation Committee

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Curious Incidents in the Careers of Hoodoo Ships

Of All Superstitions the Commonest and Best Justified Is the Belief That Some Ships Are Accursed

By Robert E. Annin

THE moving incidents of deep sea experience will always have an interest and charm, even for those whose daily occupation would tend to make them commonplace. It was by his fetching narratives that Othello induced Desdemona to waive the color line and the financial uncertainties of seaborne security are the theme of parts of the "Merchant of Venice." Certainly, unless a man is almost devoid of nerves, the anxieties of a fleet are likely to give him many nights of broken slumbers, and a feeling of trepidation as he opens the morning radiograms. From the constant strain always inherent in the business, have arisen the superstitions for which sailors as a class have been notorious, and from whom they have spread to the shore workers and offices.

In old times, for example, an owner would not sail his ship on Friday, if it could be avoided; and the average sailor would not sign on a ship booked to sail on the sixth day of the week.

But with the absolute necessity of quick turnaround on large and expensive ships the "Friday superstition" has long been falling into disuse, and steamers sail as soon as ready, wasting neither time nor money on unreasonable prejudices. The result of this has been the exploding of this particular notion, despite the "guaranteed" story of the English owner who had his ship's keel laid, ship launched, and sailed on Friday. She was named the *Friday* and was intended to break up the "Friday" idea, but she was never heard of after leaving port on her maiden voyage.

Of the superstitions which remain, the commonest, and probably the best justified, is the belief that some ships are accursed (as it used to be phrased) or, in modern vernacular, "hoodooed." Any underwriter of experience will admit that there are ships on which he will not accept any portion of the risk, although they may meet all required conditions as to construction, equipment, supply and personnel. But careful insurers refuse them simply on their record. It is impossible to say what makes a ship "unlucky," but there are vessels which no experience, foresight, care or expense seem to be able to keep out of trouble. Such ships are a sorrow to owners, a terror to operators and a thorn in the side of underwriters.

The "hoodoo" ship meets only the chances and incurs only the perils which threaten her more fortunate sisters—Acts of God, negligence, incapacity and dishonesty. But what really marks her as a "hoodoo" is that one or the other of these roots of bitterness is at work on her all the time. Hence neither ship nor owners ever get a fair chance to "rest up," physically or financially. Any ship is liable to have an occasional incompetent in command; but the hoodoo ship always has him on the hard voyage and in the emergency. Any ship may have dishonest agents and officers; the hoodoo ship has them both at the same time, working together in a distant port, where the owner will never know what is going on until too late. Ordinary ships have their hard luck spots, and get over them. The "hoodoo" distributes her misfortune economically, so as to have at least one in reserve for each new voyage.

One final peculiarity of the real hoodoo is that she never becomes a total loss. She may be stranded, sunk, burned or in collision, but there is always too much of her left to abandon. Thus she is repeatedly repaired, at an expense which fresh misfortune is likely to render useless, until age, the Act of God or the disgust of owners put her out of business. Her cargoes may be damaged, her officers wiped out, her crew swept away by pestilence, but the ship always turns up ready and anxious for more repairs. She repeatedly meets conditions which would destroy any ordinary vessel of her class; but whoever may be hurt or killed, she is always saved to gladden the heart of the drydock. Hence the time which the ordinary vessel uses to earn expenses and income is put in by the hoodoo in trying to pay for dead horses.

The St. Paul

An example of the bad combinations that strike unlucky ships may be found in the sinking of the steamer *St. Paul* in New York harbor on April 25, 1918. The vessel had been drydocked in Brooklyn and was being towed to her North River pier when she listed heavily, turned on her side and sank. Investigation showed that an ash port on her port side had been left open. This would have done no harm had her ballast been well distributed, nor even then had the ship remained on a fairly even keel during her short tow from dock to pier. But there was a good deal of wind and a swift spring tide. As the ship, rather cranky at best, met the wind and turned to cross the tide, she listed so as to put her ash port under, and the foundering followed in due course. It takes a pretty unlucky ship to have a spring tide, a head wind, and badly trimmed ballast combine with a careless seaman to sink her. And it should be remembered that had the seaman left open a port on the starboard side no harm would have ensued.

The *St. Paul*, however, had quite a record of misfortune for a passenger ship of her class. After sticking on the ways at her launching she had a rather hectic career, but the chief incidents were her sinking of the British warship *Gladiator* in 1908 and sinking herself in 1918.

A sample voyage of another unlucky steamer probably established a record in the matter of towages and ports of refuge on a transatlantic trip. She carried coal from Charleston, S. C., to Nantes in 1921. She put in at the Azores, was picked up helpless in the Bay of Biscay and towed to point St. Mathieu. Thence she proceeded to Brest for repairs and proceeded up the river for Nantes and grounded; was pulled off and towed to Nantes, repaired and sailed for home. She made port at Brest for repairs; put in at Azores for water; sailed thence for New York; was picked up 1,000 miles east of Sandy Hook and towed to Scotland light, where she was left to proceed under her own steam to quarantine. She made Gravesend Bay as her last port of refuge, anchored and whistled for a towboat. Instead of the fifty days estimated for the round trip, this ship took four months. The profits may be easily imagined. But this was not all "hoodoo." She had just undergone extensive and expensive repairs under Government supervision, and had been inspected and certified as ready for sea in hull, engines and equipment. One would like to ask who "certified" her and what he got for it.

A Real Hard-luck Ship

For the case of a genuine "Jonah" ship a part of the record of a large American schooner almost transcends belief. It should be stated for reasons obvious to those familiar with wartime construction that she was well built some years be-

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fore the war, by an excellent builder, and there was no apparent reason why she should not do at least as well as the average of her type.

In the spring of 1917 this vessel arrived at Port Natal with a cargo of lumber from "The States." She loaded a cargo for New York and sailed. Two days out, she was struck by a hurricane, suffering some damage and losing many of her sails. It was deemed wise to return to Port Natal and repair damages. She did so and a week later sailed again. Three hundred miles out she was struck by a gale, lost many sails and her anchor chains came down on her sea cock, breaking it and threatening to flood the hold. Pumps were set to work and a steamer hailed, which put out a line and started to tow. After breaking three tow lines the steamer resigned the contract and the schooner limped into port under canvas. Survey was held with the result that the ship was ordered discharged and docked; sails were ordered by cable, to come per steamer from New York. This was in mid-July, 1917. At this stage the master decided that he had had enough and resigned, turning over the command to the chief mate. The ship waited her turn at drydock until mid-September, when work was started. It was November before she was reladen and ready for sea.

The next that was heard of her she had taken refuge within the Delaware Capes, loaded with ice, running rigging frozen and crew ready to mutiny. This was early February, 1918, so that, evidently, in addition to being no Mascotte, she was no ocean greyhound. She was towed up the coast to New York and, since the topmasts were not struck before passing up the East River, she hit the Brooklyn Bridge and carried them away. She discharged a pretty good cargo (considering) and was sent to drydock for $15,000 worth of repairs (March, 1918). She waited six weeks for her turn at the dock; the repairs lasted until late July and cost $60,000.

In August, 1918, she loaded for Buenos Aires. Sailing for that port she collided with her towboat in Ambrose channel, breaking four planks, and returned for four days' repairs. Again she encountered a cyclone in the Caribbean, lost her deckload, sustained heavy damages and limped into Buenos Aires in December a partial wreck. At Buenos Aires she discharged and refitted. Cargo was damaged, and the seeds of several suits planted. The expense bill was about $40,000. She then took on a cargo of wheat for the Mediterranean and sailed; off Rio Janeiro she was found to be leaking and as the pumps were choked with wheat she put in Rio as port of refuge, making four general averages and four ports of refuge in twenty months. She sailed in April, 1919, for the Mediterranean, and in July put into the Azores, short of provisions, water and money. Finally she arrived at her discharging port in early September, having taken a year for the voyage from New York via Buenos Aires. While discharging she caught fire, but was not much damaged.

To follow in detail the history of this ship would only create incredulity. Her actual record of disaster transcends any hard luck story of Kipling or Jacobs or Clark Russell. The main incidents of the next two years are therefore merely summarized.

In September, 1920, she was partially destroyed by fire while in drydock. In October of the same year she went ashore on the Atlantic coast twice within forty-eight hours. In December she grounded in a southern port and, proceeding to sea, developed such openings of her seams that her pumps could not clear her. She was towed up a southern river and anchored over a (supposed) mud flat. When the tide went out she was found aground on an uncharted sunken rock, which almost broke her in two. In 1921 she encountered a cyclone and was towed into an Atlantic port, drydocked and fell off the blocks as the water receded. Early in 1922 she sailed from New York for the south Atlantic coast of the United States, but put back three weeks later and struck on an unknown rock in Newtown Creek.

It may be added that this schooner was launched on a Friday and stuck on the ways in launching. (This the writer understands to be a fact and not a bit of belated jocosity.)

An analysis of the three years of disaster (so far as details are available) would show that of the vessel's misfortunes about 20 percent were due to misjudgment or negligence; 30 percent to "Acts of God"; and the remaining 50 percent to an unfortunate conjunction of circumstances, aided by the causes above named, singly or together.

Now comes an oddity in the history of this floating sorrow. For over three years she had had an uninterrupted record of calamity, under good and bad agents and officers, which one may be sure were often changed. There was no question that her owners and managers had done all that care and money could do to make the ship successful. The only result had been the record above sketched, and a rising rate of insurance premiums.

The time now arrived when she could not be insured at all The owners therefore had to choose between running her uninsured or letting her rot at anchor. They chose the former *and since then have had no trouble with the ship.*

A more cheerful and yet rather surprising incident marked the voyage of the American iron ship *Brynhilda* from New York to Port Elizabeth, South Africa, in September, 1918, when our coast was haunted by hostile submarines and all traffic was under rigid rules and secret official orders. Moreover, the harbor lights were doused or changed; all ships were sailed with lifeboats provisioned and swung outward, and all use of the radio was forbidden except in last extremity: These secret orders as well as routing were given to the master only when he was on the way to his ship.

The *Brynhilda* sailed one Saturday in late September, just about dusk. Two days later one of her lifeboats was picked up off Long Beach, badly stove in and otherwise damaged, and in a condition which aroused grave fears for the ship. As she had a wireless installation, the coast was at once swept with tracing messages, but without result. All likely ports were watched for news from incoming ships, but there were none that had seen or heard of the missing vessel. As time went on and she was due to be in wireless range of the west coast of Africa, endeavors were made to trace her from there, but there was absolute silence. The friends of the officers were in despair, the owners were gloomy and the original underwriters re-insured freely, paying as high as 60 percent premium. The ship was due about Christmas, but the conviction of her loss was so strong that no one expected to hear of her. It was supposed that her bones lay within one hundred miles of the Narrows.

On Christmas morning the *New York Herald* had this simple item in the Shipping News: *"Port Elizabeth, Dec. 21st. Arr. Am. Ship Brynhilda, New York."*

One man in New York spent a large portion of his Christmas in getting hold of the families of the officers of the ship and repeating the *Herald* despatch as Christmas cheer. It was the most worth-while Christmas he ever spent—a real Christmas denouement.

What had happened was this. As soon as the tug had cast off, the ship broke out her sails and laid her course for the lightship. In the dark she was side swiped by the iron standard of a high channel buoy, carrying away a port lifeboat and part of the davits. The master would have turned back, but that would have meant two days loss of time, which was more than the boat was worth. He could not radio the accident, owing to the Navy instructions to use the wireless only in extremity. Under these circumstances, he decided to proceed, not doubting that the wrecked boat would sink with the weight of the davits and supplies. None of the tracer messages ever reached him; he had a prosperous voyage and was amazed to learn on arrival that his ship and crew had been given up for lost.

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Deadweight

By Edwin C. Bennett*

Notwithstanding the fact the deadweight carrying capacity of a ship is the factor of greatest importance to shipowners, operators, charterers and those "who go down to the sea in ships," it is noticeable that while the meaning of the term deadweight is known in a general and superficial way, a true understanding of all that the term includes is known to but a comparative few of the shipping fraternity. This lack of a full and complete understanding of what deadweight actually includes is responsible for innumerable altercations and many lawsuits between sellers and buyers, owners and charterers and others engaged in marine transportation. To aid in clearing up such misunderstandings the following explanation is offered.

IF we exclude passenger liners and certain special ships we can safely assume that deadweight is the basic income earning factor of every commercial freight carrying vessel, —it is the one income earning factor into which all expenses incurred in operating the vessel must be resolved. It is the one factor of the vessel that is marketed and upon the success or non-success of that marketing depends whether the vessel earns a profit or incurs a loss.

Deadweight, as considered in a broad and all embracing explanation of the term, is the difference between the light weight of a vessel and the displacement at any specific draft. For instance, a vessel whose light ship weight is 3,380 tons and whose displacement at 23 feet draft is 11,300 tons has a deadweight at that draft of 7,920 tons. This deadweight, however, does not represent the weight of paying or income earning cargo the vessel can carry, for many items necessary for the operation of the vessel are included therein.

Light Ship Weight

In order therefore properly to appreciate what deadweight is we must first know what is meant by light ship weight. Light ship weight is the total weight of the completed ship including its machinery with steam up and water in the boilers up to steaming level, water in the condensers, pumps, feed heater, permanent equipment such as tow lines, anchors, chains, etc., life and working boats, standing and running rigging, flags, awnings, navigating and engineering outfits and spare parts, mess, cabin and culinary outfits necessary to make the ship navigable and habitable. It does *not,* however, include coal or oil fuel either for boilers or galley use, consumable stores whether for engine, deck, cabin or galley use, drinking water, boiler feed and sanitary water, dunnage, ballast, both solid or liquid, crew and officers and their personal effects. The above excluded items are all part of the deadweight and therefore their combined weights must be deducted from the gross deadweight of the vessel at any specific draft in order to determine the actual weight of paying or income producing cargo that can be carried or marketed at that draft.

It will be seen therefore from the foregoing that when a vessel is ready to make a sea voyage a certain amount of its deadweight carrying capacity is used up even before a pound of cargo is taken on board. The amount thus taken depends, of course, upon the length of the voyage between ports for it stands to reason that a vessel whose length of voyage between ports is but 500 miles will require less fuel, water and consumable stores than a vessel whose length of voyage between ports is 2,000 miles.

Density of the Water Must Be Taken Into Account

When it comes to a question of determining both the light ship weight and the gross deadweight of a vessel from her draft figures forward and aft, the factor of the density of water must also be taken into account. It is fundamental that the weight of any floating object, such as a ship, is equal to the weight of water displaced, and, keeping in mind that at 62 degrees F. fresh water weighs approximately 62.4 pounds per cubic foot and salt water weighs 64 pounds per cubic foot, it follows that a ship floating in fresh water displaces a greater volume of water than if floating in salt water; or, in other words, the draft of water of the light ship is less in salt water than in fresh water. While there is also a difference in weight of water dependent upon its temperature—water at 85 degrees F. temperature being about ¼ pound lighter than at 35 degrees such refinement is very seldom taken into account in the general consideration of deadweight. As a matter of interest, however, in a 9,000-ton deadweight ship the difference in deadweight between sea water at 35 degrees and 85 degrees is about 50 tons at her load draft.

The great majority of shipowners, charterers, etc., in determining the deadweight capacity of a vessel for any specific draft refer to and read it from the deadweight scale or table supplied by the shipbuilder. As a matter of fact, it is the only information in their possession from which such information can be obtained, and, such being the case, it is imperative that it be correct and reliable.

Unfortunately, so many conditions are reflected in the computation of the deadweight scale, especially in the case of old vessels, that it is safe in saying a large proportion of the deadweight scales now in use on shipboard do not reflect the true deadweight that the vessel carries.

Inaccuracies in Deadweight Scale

In explanation of this assertion, it should be remembered that the deadweight scale or table is prepared by the shipbuilder's technical staff under conditions generally favorable to the vessel. Furthermore, while the shipbuilder appreciates the importance of an accurate deadweight scale, it is a matter of professional pride to show the greatest amount of deadweight for any specific draft.

At the time the shipbuilder determines the deadweight, the vessel has but few coats of paint, her ballast tanks are absolutely dry, the bottom of ship is clean, as are also the cargo holds, fuel bunkers, etc. After a vessel goes into commission, she acquires additional coats of paint, the water ballast, reserve feed water and other tanks, even when supposed to be pumped dry, contain a certain amount of water or oil, additions and changes are made to vessel, additional quarters are added, new floor covering is laid down, engine room spare parts or equipment are added—the vessel is converted to fuel oil burning while retaining her coal burning fittings, etc., all of which are accumulative and in the aggregate amount to a weight that has an appreciable bearing upon the amount of paying cargo that can be carried.

In the foregoing, the draft figures at the stem and stern of the vessel have been considered as being correctly located

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with reference to the under side of the vessel's keel, or in the case of a flat keel plate, from the underside of the keel outer buttstraps. A number of cases have occurred within the experience of the writer where the draft figures have been incorrectly located on the ship and therefore the amount of deadweight the vessel carried on any specific draft was incorrect in relation to the actual draft of the ship; or, if taken in relation to freeboard marking, it is generally less than what the vessel can actually carry.

It is desirable, therefore, that shipowners, especially in the case of old ships, or those known to have had extensive additions or alterations made thereon, have the deadweight scale or table checked up to assure themselves of its accuracy. Such a check should always be demanded by the prospective purchaser of an old ship in order to be assured that the deadweight as stated by the seller or as shown on the vessel's deadweight capacity tables is reasonably accurate and has taken account of the increased light ship weight that comes with years of service.

DEADWEIGHT CARRYING VS. PAYING CARGO CAPACITY

In order to illustrate more clearly the relationship between the deadweight carrying capacity and the paying cargo carrying capacity, there is given below the weights for a cargo carrying vessel of the usual type reputed to be of 7,800 tons deadweight, but which actually carried, at the time she was built, 7,868 tons at her legal summer freeboard draft—the vessel being outfitted for a voyage of 3,600 miles.

WEIGHTS FOR CARGO VESSEL OF 7,800 TONS DEADWEIGHT

	Light Ship, Tons	Deadweight, Tons
Weight of dry ship at time of her completion by shipbuilder	3,268	
Water in boilers, condensers, pumps, etc.	82	
Additions to structure and equipment added after vessel left shipyard	30	
Actual present light ship weight	3,380	
Coal for 3,600 miles plus reserve		700
Reserve feed water for boilers		120
Drinking water		20
Sanitary water		5
Galley stores, galley coal, etc.		15
Deck and steward's stores		25
Engine room stores		5
Crew and effects		6
Water in ballast tanks that cannot be removed by pump suctions		10
Dunnage for cargo		2
Non-income producing deadweight		908
Weight of income producing or paying cargo		6,960
Total gross deadweight		7,868

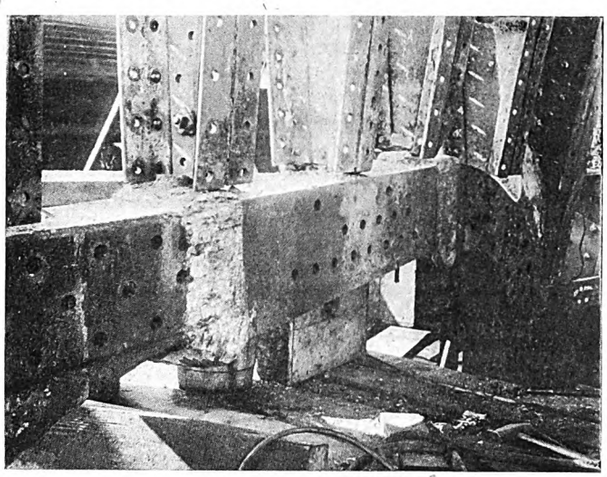
Inasmuch as the tons per inch at load draft were approximately 44, it will be seen that about 20 inches of the vessel's draft was taken up by non-income producing deadweight, or putting it in another way, about 11½ percent of the gross deadweight is required for non-income paying items. Of this 11½ percent some 90 percent is in turn taken up by the combined weights of coal and reserve feed water.

While it has but an indirect bearing upon the foregoing explanation of deadweight an analysis of the above table will show that in order to increase the weight of paying or income producing cargo that can be carried, it is necessary to reduce either the weight of the light ship or the fuel and boiler feed water or both. Any type of machinery that will reduce the consumption of fuel and feed water will obviously increase the weight of income producing cargo that can be carried and is therefore a subject that should be seriously investigated by all shipowners.

Resolute's Stern Frame Successfully Welded

ON November 17 an inspection of the transatlantic liner *Resolute* of the United American Lines, which was in dry dock at the Morse Dry Dock & Repair Company, Brooklyn, N. Y., revealed the presence of a fracture directly through a splice half way out on the 10 inch by 15 inch stern shoe.

To have replaced the old 16-ton casting by a new one would have cost many thousands of dollars and involved unshipping the old section, purchasing a new casting and installing and machining a new splice. This course of procedure would also have delayed work on other alterations to the vessel while in dry dock, preparatory to sending the ship



Repairing Stern Shoe of S. S. Resolute. Thermit Welds With Collar on Side Chipped Off to Allow Replacement of Plates

on a cruise around the world, which could not be attempted until the stern shoe was repaired.

It was found entirely feasible, however, to save much time and money by means of Thermit welding. Instead of making a weld through the broken splice, it was recommended that a more satisfactory job could be obtained by cutting out the splice and welding in a new billet by making two welds, thereby entirely eliminating any mechanical connection and obtaining one solid section of much greater than the original strength. The method of welding suggested was approved by the dry dock company, which in turn obtained the approval of German Lloyds, under whose registry the *Resolute* was classified.

Permission to weld being granted, the dry dock representatives lost no time in removing adjacent plates, cutting out the old splice and forging, machining and inserting a new billet, 4 feet in length, in place ready for the welding force to proceed. Work began at 9 A. M. Sunday, November 19, at which time the wax patterns were applied. By 5 P. M. the mold boxes were in place and had been rammed. Pre-heating was then started, using one heating gate on each side of each weld. Pre-heating was continued steadily until midnight, when the charges of Thermit in the crucibles, suspended by chains over the mold, one crucible on each side for each weld, were ignited and the welds poured simultaneously.

The welds were allowed to cool over night and the following day the mold was stripped off and risers and pouring gate removed. The collars of the welds were chipped off on the sides, in order to allow replacement of plates. The weld on inspection was found to be perfect in every respect and additional repairs were started under way promptly.

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Recent Developments in Marine Insurance

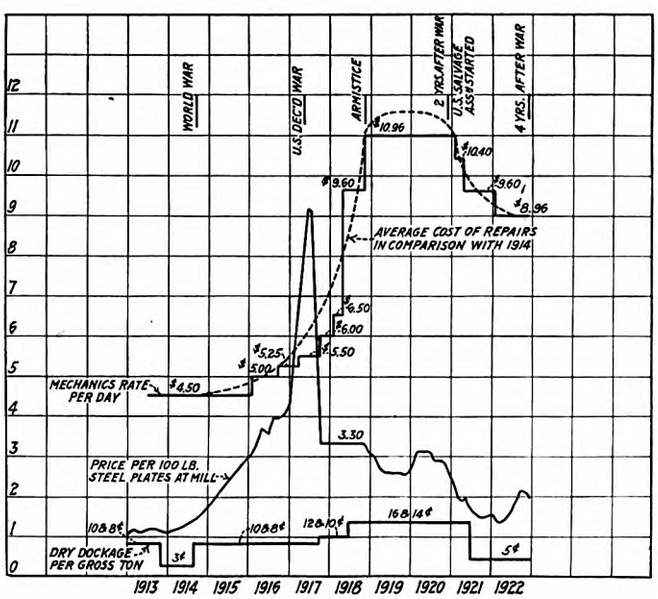
Review of 1922—High Repair Costs—Turkish Monopoly—New P. and I. Bureau—Unseaworthiness—Danube Scheme

By "Bordereaux"

OF the year so recently ended it may be said to have been, so far as marine insurance is concerned, one of encouragement and advance. The reaction from the disastrous experiences of 1921 was marked, and the year closed with an improvement in premium volume, reduction of losses and general betterment of conditions. It was a distinct period of reconstruction. It opened under circumstances of discouragement, because many companies were failing and retiring, both here and abroad, and because losses were coming in steadily for three years' accounts. Foreign trade was almost dormant; there was practically nothing to write. Then things began to look up. The flow of losses abated, particularly as regards theft and pilferage, shipments of cotton and grain to Europe aroused something of the old animation in the market, and trade began to quicken from Cuba and South America. Thus, when 1922 passed out it left the marine underwriters with quite as much of an income as they had had the previous year, and considerably less money to have to pay for losses. It's encouraging.

Ship Repair Costs High

AN interesting graph has been prepared by the United States Salvage Association which reflects a comparative study of ship repair costs in the New York District covering the period from 1913 to and including 1922.



Data Compiled by United States Salvage Association Showing Cost of Ship Repairs in New York District

The average cost curve is influenced chiefly by three factors: Labor rates, drydockage and the price of steel. These are the dominating influences, although there are other minor factors such as freight rates, overhead and handling charges, etc. This graphic picture shows that the cost of effecting repairs at the present time is about 100 percent greater than in pre-war days.

Dividing the total cost into its component parts, it is of interest to trace the rises and falls in the cost of individual items. Take ship mechanics' wages, for example. Starting with an average wage of $4.50 in 1914 and 1915, the scale rose rapidly until, for the two years subsequent to the armistice, it rested at $10.96 per diem. It has declined somewhat since, but still stands at the high figure of $8.96. Prices for steel plates at the mill present a no less significant history. As soon as the late war broke out they began to ascend from $1 per hundred pounds until they reached $4.50 a hundred shortly after the United States entered the conflict. The decline, when it came, was equally precipitant, reaching the $3.30 level in the late fall of 1917. Early in 1922 it got down to $1.30, when it started upward once more and is now in the neighborhood of $2. Dry-dockage costs, on the per gross ton basis, rose to 16 and 14 cents from between 1918 until the close of 1921, but has since declined to 5 cents, which is practically the rate charged in 1914 and materially less than that of 1913.

Turkish Monopoly Proposed

TURKEY is accumulating confidence at such a rate that it plans making a monopoly of all kinds of insurance. If its tentative arrangements go through it will expel all foreign insurance interests and found a bank to carry on the business. This might, at first blush, look bad for foreign merchants doing business in Turkey, but there will doubtless survive the principle of extra-territoriality—for that is something the European Governments will never relinquish—and the result will doubtless be that English and American shippers, for example, will insist upon coverage in companies whose strength they are acquainted with and will let the foreign-hating Turkish bank severely alone.

Government P. and I. Bureau

AS is generally understood, there are numerous liability hazards that are not covered by the ordinary marine insurance policy—such as personal injury, sickness, cargo damage, immigration fines, etc. These have heretofore been separately written by the American Steamship Owners' Protective and Indemnity Association, and Shipping Board vessels have been covered in that way. But it has been decided by the latter to withdraw the Emergency Fleet Corporation from this Association on February 20 and to insure its P. and I. liability in a new organization of its own launching, which is to be known as the United States Protective and Indemnity Agency, Inc. It is to be located in the Shipping Board offices in New York City, and Nathan A. Smyth, general counsel for the Shipping Board, has been selected to be its president. It will begin to operate on February 20.

The idea is to give this body a world-wide scope and representatives are being appointed in all the principal ports of the world. Close cooperation is to be had with managing agents and they will be given considerably more latitude as respects claim settlements. There is to be no separate insurance fund established, but current receipts will be used to meet claims. The field of the new bureau will be one of adjusting and investigation.

Relative to the past P. and I. experiences of the Shipping

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Board, Commissioner Lissner has recently given out the following data:

The Shipping Board paid into the Steamship Owners' Association last year about $5,000,000 in premiums, but later reduced this expense about $2,000,000 by withdrawing insurance for its idle fleet. Under the new arrangements the Emergency Fleet Corporation will carry its own insurance, just as is already done with regard to all other Government insurance risks. Losses will be paid out of funds appropriated by Congress for maintenance of the Emergency Fleet Corporation as a shipbuilding concern. The United States P. & I. Agency will serve only as a loss adjustment agency.

The former Shipping Board believed it advantageous to enter into the American Steamship Owners' Protective & Indemnity Association in order to build up this form of mutual marine insurance organization in America, whereas formerly all such organizations had been under British control. And, moreover, at that time the Shipping Board had its hands full with a construction program and the organization chaos growing out of the war pressure.

But now the American Steamship Owners' Association has expanded until it has entered on its books more than two million gross tons of privately owned shipping besides that belonging to the Shipping Board. And, also, the Shipping Board has built up an organization within itself capable of handling much of the work that has been handled by the American Steamship Owners' Association. The new arrangement will do away with most of this duplication of effort.

The withdrawal of the Shipping Board from the American Steamship Owners' Protective & Indemnity Association opens up a number of technical questions relating to the liability of the Shipping Board in connection with past transactions with the American Steamship Owners' Association. The Shipping Board believes itself entitled to large refunds on business handled by the association in the past. It is the intention of the Shipping Board to press these claims against the association so that in the final settlement an equitable adjustment may be made.

Average for Stiffening

CHARTERERS may maintain a claim to general average contribution against the owners of a vessel in such an instance as when it is necessary to remove coal that was taken aboard for stiffening and which subsequently became heated and imperiled the ship prior to loading. This was decided in a case recently tried before the United States Circuit Court of Appeals, Aktieselskabet Fido v. Lloyd Braziliero et al., 283 Fed. Rep. 62. The court held that all losses in a maritime adventure falling outside the contractual obligations of the parties, and which arise from a voluntary sacrifice of a part of the cargo, made to save the whole adventure from perishing, or which arise out of extraordinary expenses or expenditures of money incurred for the joint benefit of both ship and cargo, constitute a claim to general average contribution.

The circumstances of this case were unusual. Seven steel sailing vessels were involved, all the property of the Norwegian company, under charter by the respondents to carry full cargoes of coal from Hampton Roads, Va., to South American ports. The charter parties carried the anomalous provision that the charterer should furnish ballast, or a part cargo of coal, as stiffening, to enable the vessels to proceed from their inward ports of discharge under previous charters. Bituminous steam coal was taken on for this purpose at New York and Baltimore to make the run to Hampton Roads for the full cargoes. While the ships were waiting their turn at the loading pier of the latter place it was discovered that the coal stiffening had become so heated as to make it unsafe to load the balance of the coal full cargoes; and the stiffening was accordingly removed and entire new cargoes loaded, after which the vessels proceeded to their respective destinations in South America. It was agreed on both sides that the removal of the stiffening coal was necessary, but because of the delay and expense involved a difference of opinion arose between owners and charterers as to the rights and liabilities of the respective parties. One of the questions was as to when lay days began to run; this was decided by the court to be after the removal of the heated stiffening.

Amendments to Repairs Tariff

SHORTLY before the close of the year amendments to customs regulations were promulgated by Assistant Secretary of the Treasury Clifford, but they fail to help the underwriters out of their dilemma on the subject of repairs duty refunds. The Clifford amendments are intended to give the necessary procedure in case of making entries in connection with repairs made abroad subject to duty under the new tariff. They do not clear up any of the ambiguities of the new Act that are proving so puzzling. In a word, the amendments are of method only, prescribing procedure, and further Treasury rulings must be forthcoming, if vessel owners and marine underwriters are to know just where they stand in respect to such points as we pointed out in this department in our January issue.

Unseaworthiness

THE burden of proof on the issue of unseaworthiness in a suit on a marine policy rests with the insurer, and under the "Sue and Labor" clause the insurer is not liable for contribution to the expenses incurred. These are among the interesting points held by the United States Circuit Court of Appeals, Third Circuit, New York, in the suit brought by the Liberty Sand & Gravel Company, Inc., against the American Merchant Marine Insurance Company, 282 Fed. Rep. 514.

Liability on the Danube

HITHERTO it has been customary on the Danube for shipping companies to either totally exclude any liability for goods taken over by them, or to restrict it to such small sums that the shippers have been obliged to insure the goods themselves. But now the associated Danube shipping companies have decided to assume liability for loss, damage and non-delivery and all risks to cargo (excluding acts of God, peculiar nature of the goods, personal negligence of the despatcher or consignee, etc.). To this end, in addition to the freight and other charges, they are levying on the goods a special supplementary liability charge and, in consideration of this, will pay to the shipper the full market value of the goods on the day and place when and whence they are taken, and possibly also an additional sum of 15 percent of this value as compensation for lost profit. The shipping companies have also made arrangements that goods destined for transport on the Danube can be, or are, covered for the preliminary or subsequent railway transport, in so far as the receiving railway station and the preliminary and subsequent railway transport and the railway station at the point of destination lie within the territory of the Danube States, and so long as the preliminary and subsequent railway transport is not used as a means of avoiding transport by water. Special supplementary charges are to be levied for the handling of goods during the winter.

Company Merger

THE Washington Marine Insurance Company, which was organized in 1918 and has chiefly done a marine business, has been merged with the United States Lloyds of 1 South William street, New York. The assets and outstanding business of the former were taken over as of January 1, 1923, and the New York Insurance Department has given the merger its official sanction. Thus passes still another of the "war babies" that were attracted to marine insurance by the glittering prospects of war risk business but could not find a reason for existence when there was nothing in sight but straight marine insurance.

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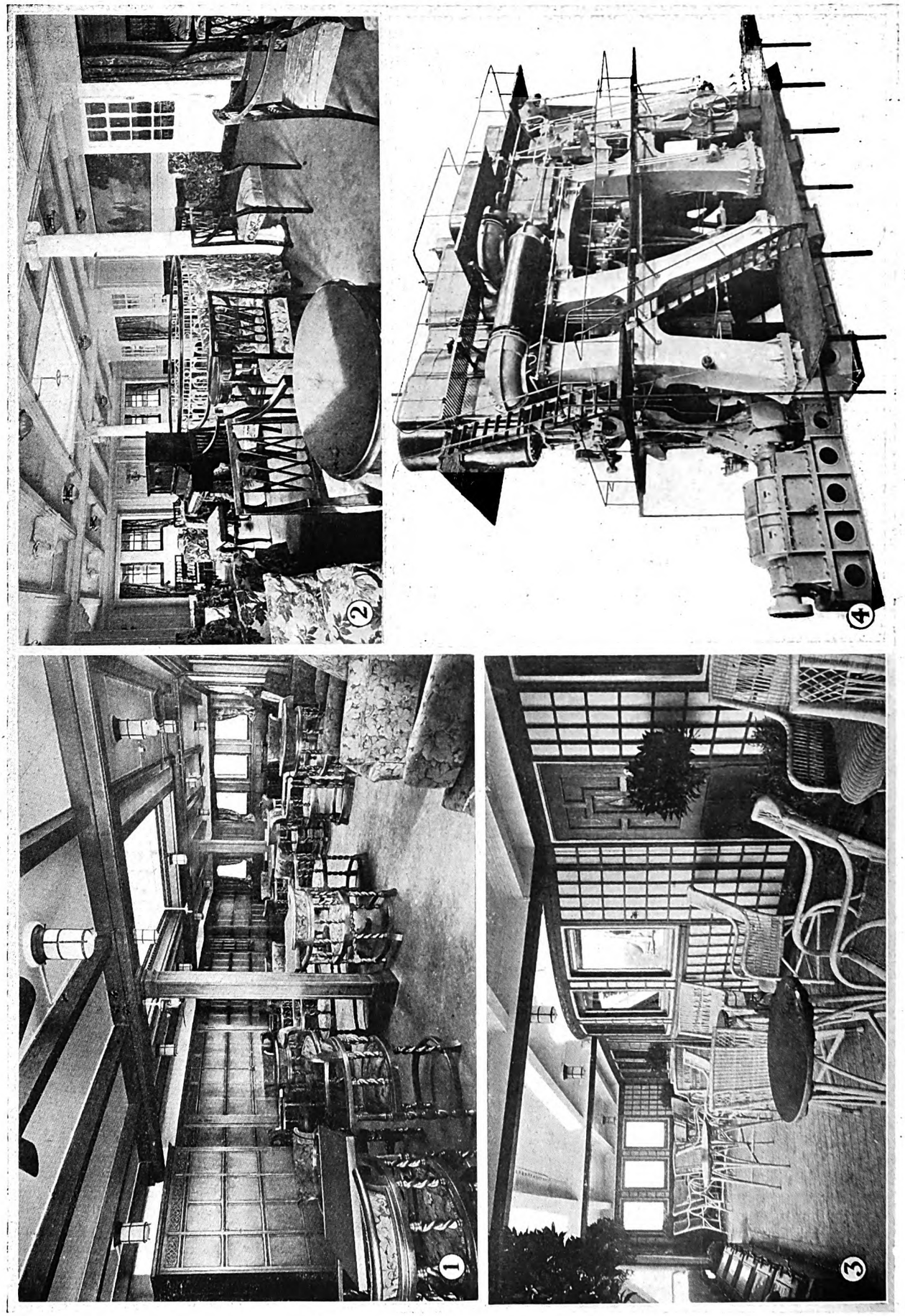

S. S. City of Nagpur; (1) First Class Smoking Room, (2) First Class Lounge, (3) Ver anda Cafe, (4) Main Engine

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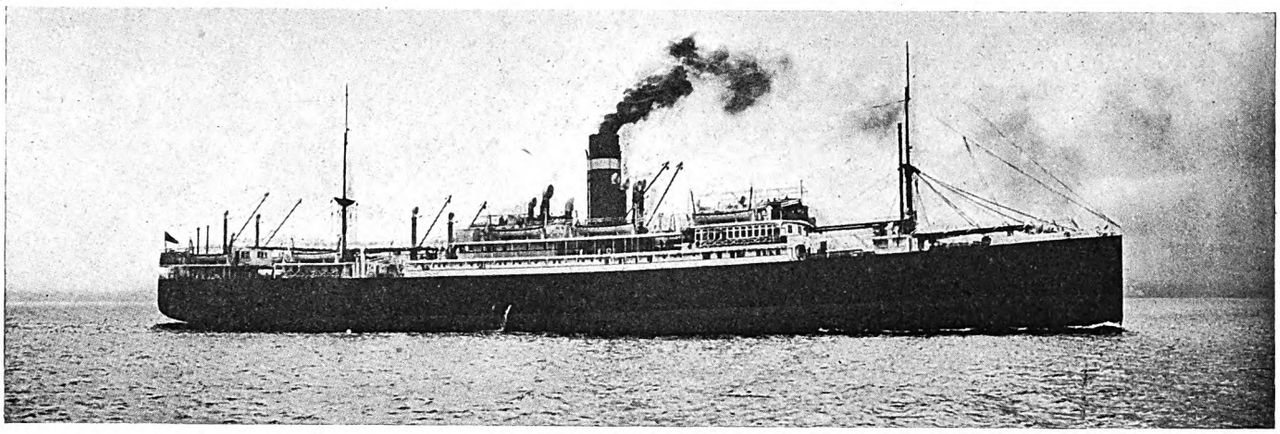


The City of Nagpur Under Way in Light Condition

Passenger and Cargo Steamship City of Nagpur

Recently Completed by Workman, Clark and Company, Ltd., Belfast, Ireland, for City Line Fleet of the Ellerman Lines, Ltd.

THE *City of Nagpur*, a passenger and cargo steamer of the shelter deck type, over 490 feet in length, with a tonnage of 10,200 tons, has just been built by the well-known Belfast shipbuilding and engineering firm of Messrs. Workman, Clark & Company, Ltd., under special survey for the highest class in Lloyd's Register and to fulfill the latest requirements of the British Board of Trade for passenger service between Great Britain and India.

The vessel is fitted with the latest approved safety appliances, close spaced watertight bulkheads carried up to the superstructure deck, wireless telegraphy, and boats for all, the boats being handled by mechanically operated davits. A motor driven emergency dynamo is fitted on the boat deck, capable of carrying on the lighting and wireless service. This dynamo also supplies power to drive an electric pump for emergency service.

Passenger Accommodations

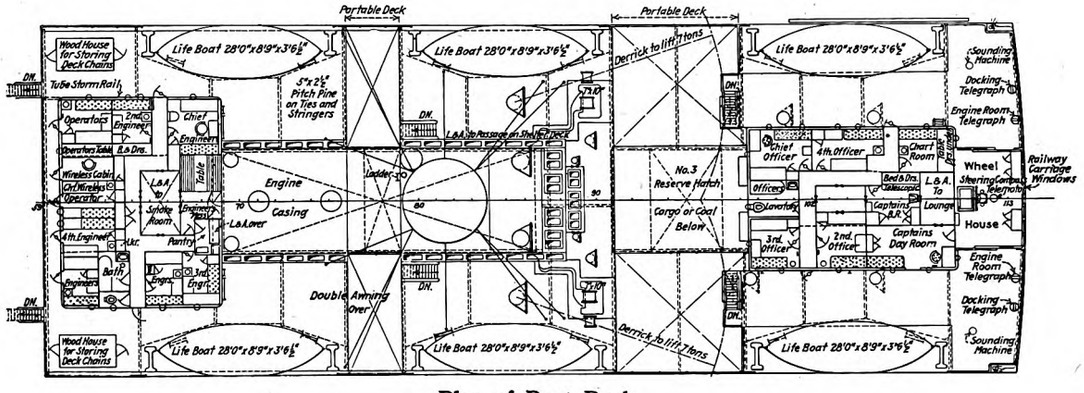
In designing the vessel special attention has been given to the arrangement of the passenger accommodation, provision being made for 226 first class passengers in staterooms arranged amidships on the upper, shelter and promenade decks, while 92 second class passengers are accommodated in staterooms on the upper deck. All the staterooms are roomy, well ventilated and each is provided with a large window or side-light, electric fan, wardrobes, large mirror and porcelain wash basin with a continuous supply of fresh water. All rooms are heated by steam and lighted by electricity.

A large number of single berth, two berth and three berth cabins are provided, and communicating doors are arranged between the staterooms so that they can be used en suite if desired. A number of the staterooms are provided with bedsteads instead of superimposed berths.

First Class Public Rooms

The dining saloon on the shelter deck extends nearly the full width of the ship. In this room the paneling is in the Georgian style, painted in delicate tones of ivory with gilt enrichments. Large rectangular windows at the front and sides, together with a central well overhead, afford abundant light to all parts of the room, while numerous electric fans fitted on the ceiling add to the ventilation. A broad mahogany staircase, with metal balustrades, leads from the saloon to the main entrance hall which is situated on the promenade deck above.

The lounge adjoining the entrance hall is decorated in the Louis XIV style in white and gray. This room is artistically furnished and is abundantly lighted in front and at the



Plan of Boat Deck

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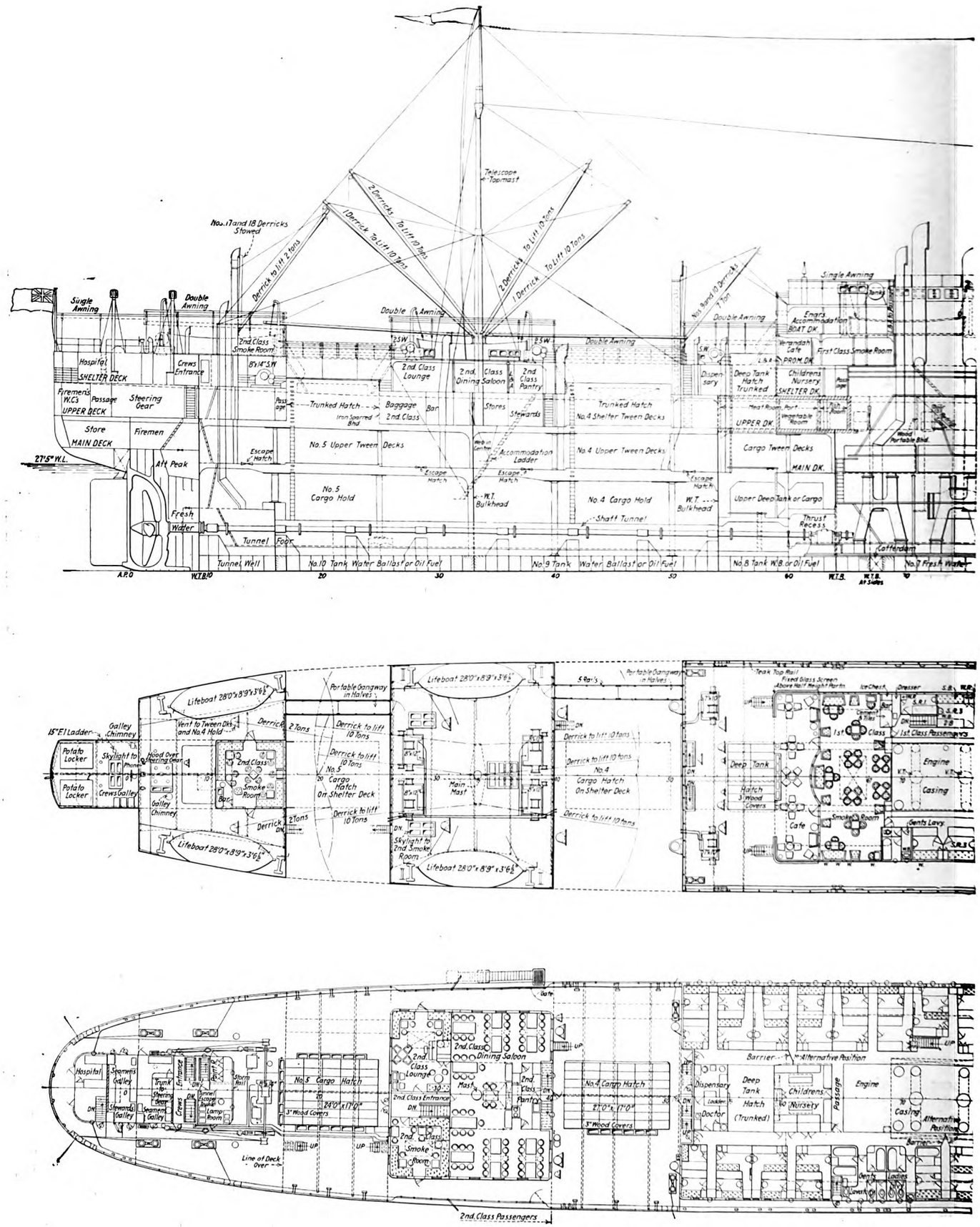

Inboard Profile and Plans of Promenade and Shelter Decks

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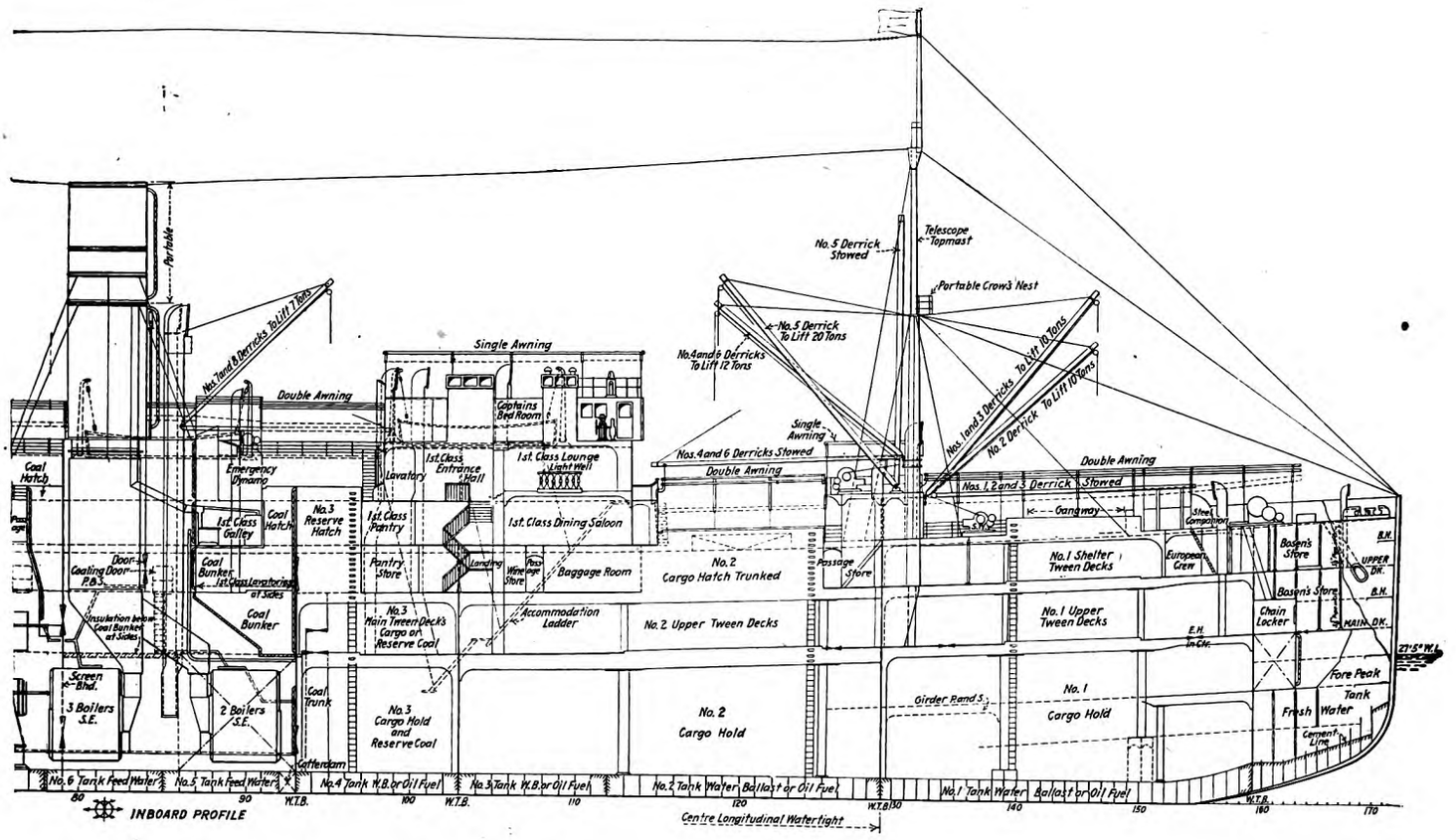

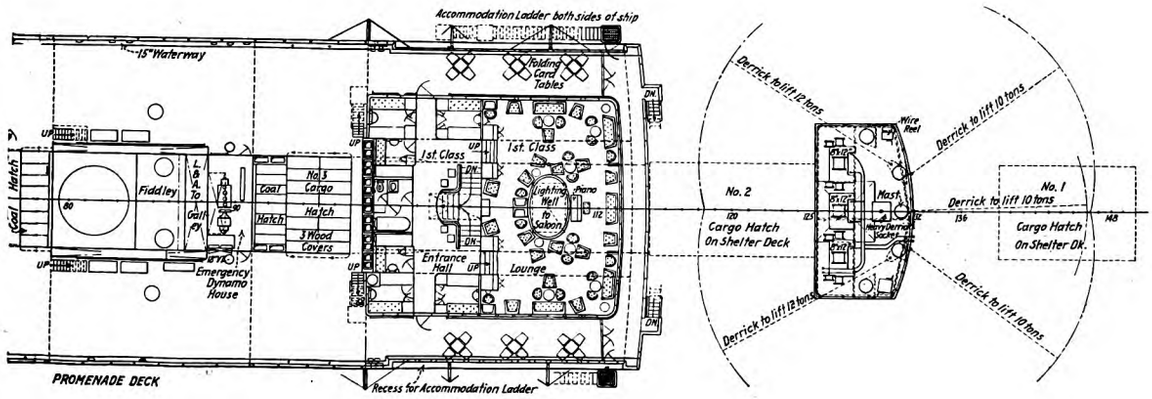

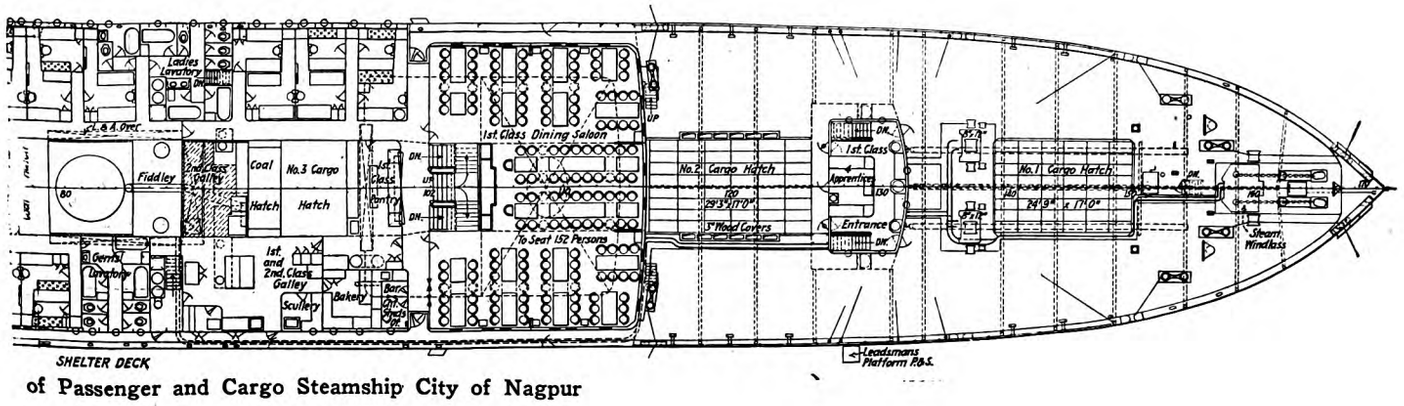

of Passenger and Cargo Steamship City of Nagpur

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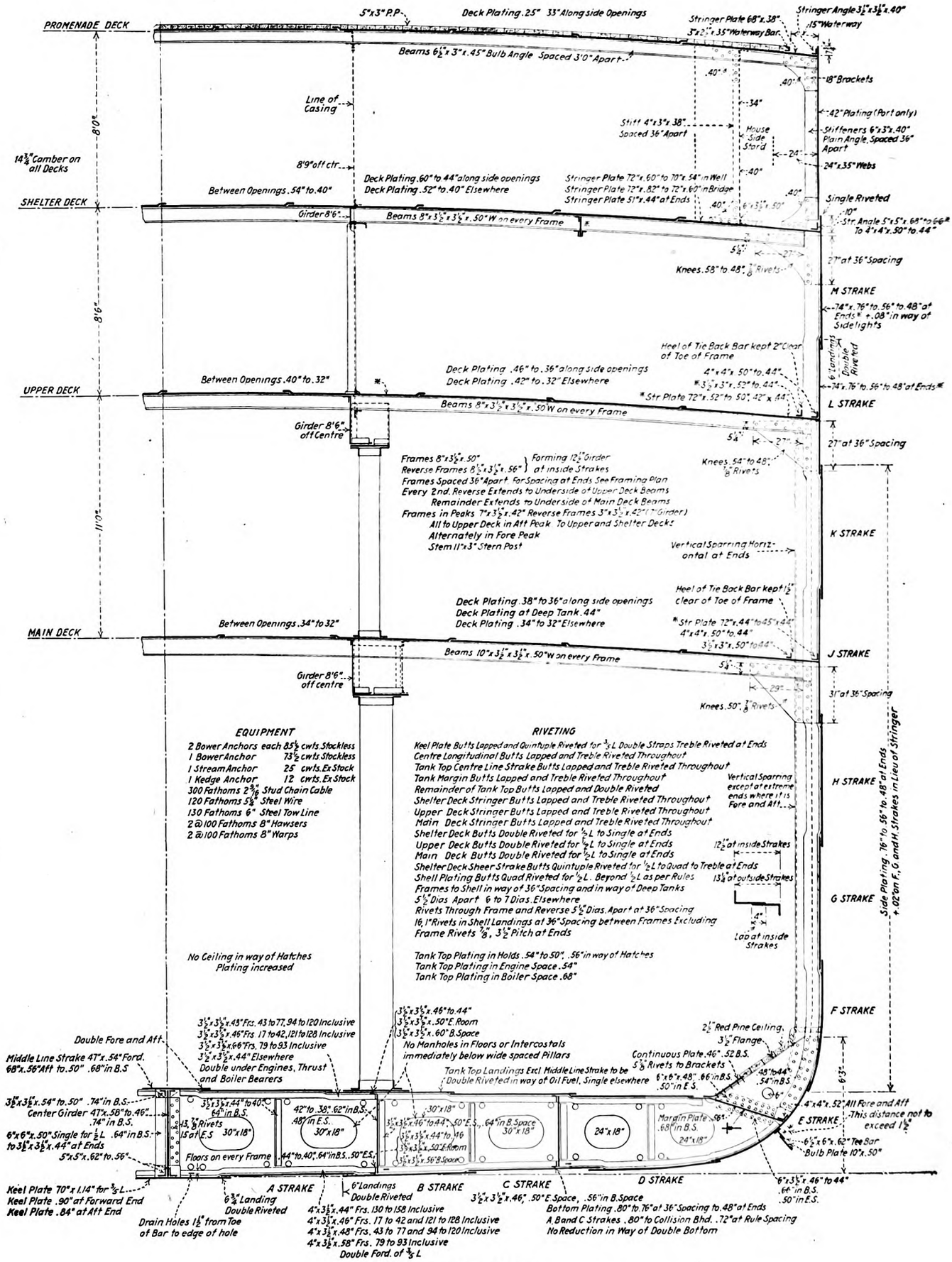
PROMENADE DECK
SHELTER DECK
UPPER DECK
MAIN DECK
8'0"
8'6"
11'0"
14⅜" Camber on all Decks
5"x3" P.P.
Deck Plating .25" 33" Along side Openings
Stringer Plate 68"x.38"
Stringer Angle 3½"x3½"x.40"
3"x2½"x.35" Waterway Bar
.15" Waterway
Beams 6½"x3"x.45" Bulb Angle Spaced 3'0" Apart
18" Brackets
Line of Casing
8'9" off ctr.
Stiff 4"x3"x.38" Spaced 36" Apart
42" Plating (Port only)
Stiffeners 6"x3"x.40" Plain Angle, Spaced 36" Apart
24"x.35" Webs
Deck Plating .60" to 44" along side openings
Deck Plating .52" to .40" Elsewhere
Stringer Plate 72"x.60" to 70"x.54" in Well
Stringer Plate 72"x.82" to 72"x.60" in Bridge
Stringer Plate 51"x.44" at Ends
Between Openings .54" to .40"
Girder 8'6"
Beams 8"x3½"x3½"x.50" W on every Frame
Single Riveted
Str. Angle 5"x5"x.68" to 66" To 4"x4"x.50" to .44"
Knees .58" to 48" ⅞" Rivets
27" at 36" Spacing
M STRAKE
74"x.76" to .56" to .48" at Ends* +.08" in way of Sidelights
Heel of Tie Back Bar kept 2" Clear of Toe of Frame
Deck Plating .46" to .36" along side openings
Deck Plating .42" to .32" Elsewhere
Between Openings .40" to .32"
4"x4"x.50" to .44"
3½"x3"x.52" to .44"
Str. Plate 72"x.52" to 50", 42"x.44"
74"x.76" to .56" to .48" at Ends*
L STRAKE
Beams 8"x3½"x3½"x.50" W on every Frame
Girder 8'6" off Centre
Frames 8"x3½"x.50"
Reverse Frames 8½"x3½"x.56" } Forming 12½" Girder at inside Strakes
Frames Spaced 36" Apart For Spacing at Ends See Framing Plan
Every 2nd. Reverse Extends to Underside of Upper Deck Beams
Remainder Extends to Underside of Main Deck Beams
Frames in Peaks 7"x3½"x.42" Reverse Frames 3"x3½"x.42" (T Girder)
All to Upper Deck in Aft Peak To Upper and Shelter Decks
Alternately in Fore Peak
Stem 11"x3" Stern Post
Knees .54" to 48" ⅞" Rivets
27" at 36" Spacing
K STRAKE
Vertical Sparring Horizontal at Ends
Deck Plating .38" to 36" along side openings
Deck Plating at Deep Tank .44"
Deck Plating .34" to 32" Elsewhere
Heel of Tie Back Bar kept ½" clear of Toe of Frame
Between Openings .34" to 32"
Str. Plate 72"x.44" to 45"x.44"
4"x4"x.50" to .44"
3½"x3"x.50" to .44"
Beams 10"x3½"x3½"x.50" W on every Frame
Girder 8'6" off centre
Knees .50" ⅞" Rivets
31" at 36" Spacing
J STRAKE
H STRAKE
Vertical Sparring except at extreme ends where it is Fore and Aft
12½" at inside Strakes
13⅜" at outside Strakes
4" Lap at inside Strakes
G STRAKE
Side Plating .76" to .56" to .48" at Ends +.02" on F, G and H Strakes in Lieu of Stringer
F STRAKE
2½" Red Pine Ceiling, 3½" Flange
Continuous Plate .46" .52 B.S.
5⅞" Rivets to Brackets
.48" to .44"
.54" in B.S.
6'9"
4"x4"x.52" All Fore and Aft This distance not to exceed 1⅛"
E STRAKE
6"x3½"x.46" to .44"
.66" in B.S.
.50" in E.S.
6"x6"x.62" Tee Bar
Bulb Plate 10"x.50"
D STRAKE
C STRAKE
B STRAKE
A STRAKE
6" Landings Double Riveted
6¾" Landing Double Riveted
Keel Plate 70"x1.14" for ⅜ L
Keel Plate .90" at Forward End
Keel Plate .84" at Aft End
Drain Holes 1½" from Toe of Bar to edge of hole
Double Fore and Aft
Middle Line Strake 47"x.54" Ford. 68"x.56" Aft to .50" .68" in B.S
3½"x3½"x.54" to .50" .74" in B.S.
Center Girder 47"x.56" to .46" .74" in B.S.
6"x6"x.50" Single for ½ L .64" in B.S. to 3½"x3½"x.44" at Ends
5"x5"x.62" to .56"
3½"x3½"x.43" Frs. 43 to 77, 94 to 120 Inclusive
3½"x3½"x.46" Frs 17 to 42, 121 to 128 Inclusive
3½"x3½"x.66" Frs. 79 to 93 Inclusive
3½"x3½"x.44" Elsewhere
Double under Engines, Thrust and Boiler Bearers
43 ⅞" Rivets 15 at F.S
30"x18"
Floors on every Frame
3½"x3½"x.44" to 40" 64" in B.S.
42" to 38" .62" in B.S.
.48" in E.S.
.44" to .40" .64" in B.S., .50" E.S.
3½"x3½"x.46" to .44" .50" E.S., 64" in B.Space
3½"x3½"x.44" to .46
3½"x3½"x.50" E.Room
3½"x3½"x.56" B.Space
24"x18"
Margin Plate .68" in B.S.
3½"x3½"x.46" to .44"
3½"x3½"x.50" E.Room
3½"x3½"x.60" B.Space
No Manholes in Floors or Intercostals immediately below wide spaced Pillars
Tank Top Landings Excl Middle Line Strake to be Double Riveted in way of Oil Fuel, Single elsewhere
4"x3½"x.44" Frs. 130 to 158 Inclusive
4"x3½"x.46" Frs. 17 to 42 and 121 to 128 Inclusive
4"x3½"x.48" Frs. 43 to 77 and 94 to 120 Inclusive
4"x3½"x.58" Frs. 79 to 93 Inclusive
Double Ford. of ⅜ L
3½"x3½"x.46", .50" E.Space, .56" in B.Space
Bottom Plating .80" to .76" at 36" Spacing to .48" at Ends
A Band C Strakes .80" to Collision Bhd. .72" at Rule Spacing
No Reduction in Way of Double Bottom
EQUIPMENT
2 Bower Anchors each 85½ cwts. Stockless
1 Bower Anchor 73½ cwts. Stockless
1 Stream Anchor 25 cwts. Ex Stock
1 Kedge Anchor 12 cwts. Ex Stock
300 Fathoms 2 3/16" Stud Chain Cable
120 Fathoms 5/8" Steel Wire
130 Fathoms 6" Steel Tow Line
2 @ 100 Fathoms 8" Hawsers
2 @ 100 Fathoms 8" Warps
RIVETING
Keel Plate Butts Lapped and Quintuple Riveted for ⅜ L Double Straps Treble Riveted at Ends
Centre Longitudinal Butts Lapped and Treble Riveted Throughout
Tank Top Centre Line Strake Butts Lapped and Treble Riveted Throughout
Tank Margin Butts Lapped and Treble Riveted Throughout
Remainder of Tank Top Butts Lapped and Double Riveted
Shelter Deck Stringer Butts Lapped and Treble Riveted Throughout
Upper Deck Stringer Butts Lapped and Treble Riveted Throughout
Main Deck Stringer Butts Lapped and Treble Riveted Throughout
Shelter Deck Butts Double Riveted for ½ L to Single at Ends
Upper Deck Butts Double Riveted for ½ L to Single at Ends
Main Deck Butts Double Riveted for ½ L to Single at Ends
Shelter Deck Sheer Strake Butts Quintuple Riveted for ½ L to Quad to Treble at Ends
Shell Plating Butts Quad Riveted for ½ L. Beyond ½ L as per Rules
Frames to Shell in way of 36" Spacing and in way of Deep Tanks
5½" Dias Apart 6 to 7 Dias. Elsewhere
Rivets Through Frame and Reverse 5½" Dias. Apart at 36" Spacing
16 1" Rivets in Shell Landings at 36" Spacing between Frames Excluding Frame Rivets ⅞", 3½" Pitch at Ends
No Ceiling in way of Hatches Plating increased
Tank Top Plating in Holds .54" to 50", .56" in way of Hatches
Tank Top Plating in Engine Space .54"
Tank Top Plating in Boiler Space .68"

Midship Section

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sides by rectangular windows and overhead by a handsome stained glass roof light.

The first class smoking room, situated at the after end of the promenade deck, is a large airy apartment tastefully furnished and decorated in oak. The wall paneling is in the Tudor style relieved by prints and engravings of the old masters. Rectangular plate glass sliding windows at the sides and a large decorative skylight overhead give ample light and ventilation.

Adjoining, and forming an extension of the smoke room, is the verandah cafe extending from side to side. The walls are stone color with teak trellis work, and boxes of flowers and large palms contribute to the decorative effect.

Second Class Public Rooms

The second class public rooms are situated in a separate deckhouse on the shelter deck. The dining saloon is decorated in white with a dado of polished mahogany. The room is ventilated and lighted by large rectangular windows at the sides and forward end and by a skylight overhead. Immediately abaft is the entrance hall, from which a mahogany staircase leads to the staterooms.

The second class smoking room, paneled in oak, adjoins the entrance hall. A supplementary smoking room has also been provided on the after boat deck for the use of the second class passengers.

The second class lounge adjoining is pleasingly decorated in white, with a polished mahogany dado.

A large section of the promenade deck space on either side at the forward end abreast the lounge is enclosed by a steel screen in which large sliding windows have been arranged. The whole combines to form an ideal open-air lounge regardless of the weather.

Cargo Handling Arrangements

For cargo handling the vessel has six hatches served by a total of 16 derricks (including one for heavy lifts) and 14 steam winches. These winches which are situated near the passenger accommodation are of the silent type, to avoid the vibration and noise generally associated with working machinery.

The cargo holds are built on the wide spaced pillar and girder principle, which gives a minimum amount of obstruction in dealing with large consignments.

Propelling Machinery

The propelling machinery, also constructed by Messrs. Workman, Clark and Company, Ltd., consists of one set of quadruple expansion engines balanced on the Yarrow, Schlick and Tweedy system, capable of developing over 6,000 indicated horsepower. Steam is supplied by five Scotch boilers fitted with forced draft and arranged to burn either coal or oil fuel. The electric power is generated by three large dynamos, which supply the lighting of the ship, the wireless telegraphy apparatus and drive the numerous auxiliary motors.

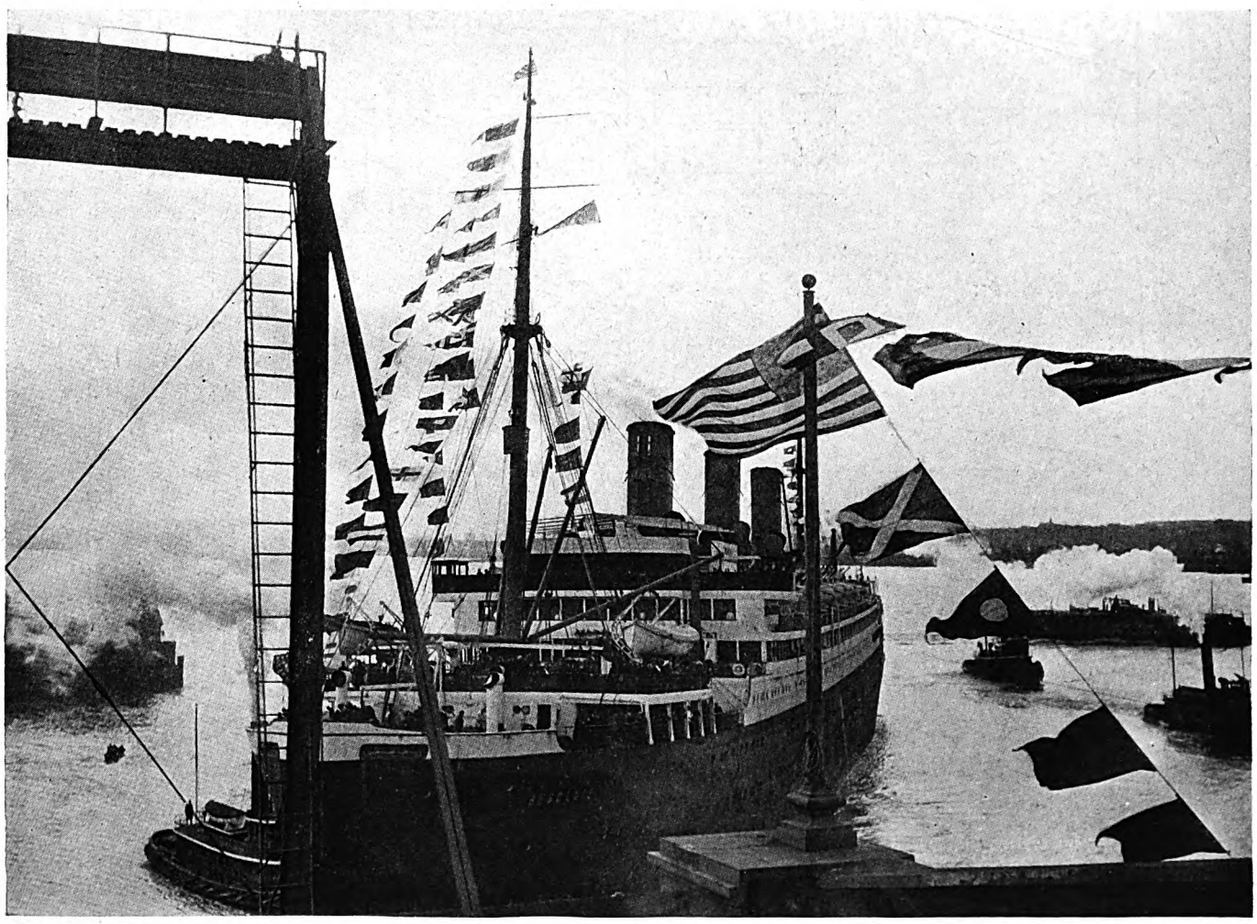

Photo Kadel & Herbert News Photos.

Dry Law Forces American Ship Under Registry of Panama. S. S. Resolute Now "Wet" on World's Tour

The S. S. Resolute of the United American Line, just recently built, one of the finest afloat, leaves on a world's tour under the registry of the Panama Government. Just recently the American flag was hauled down and the Panama flag substituted to enable the ship to make the world's tour without infringing America's dry law.

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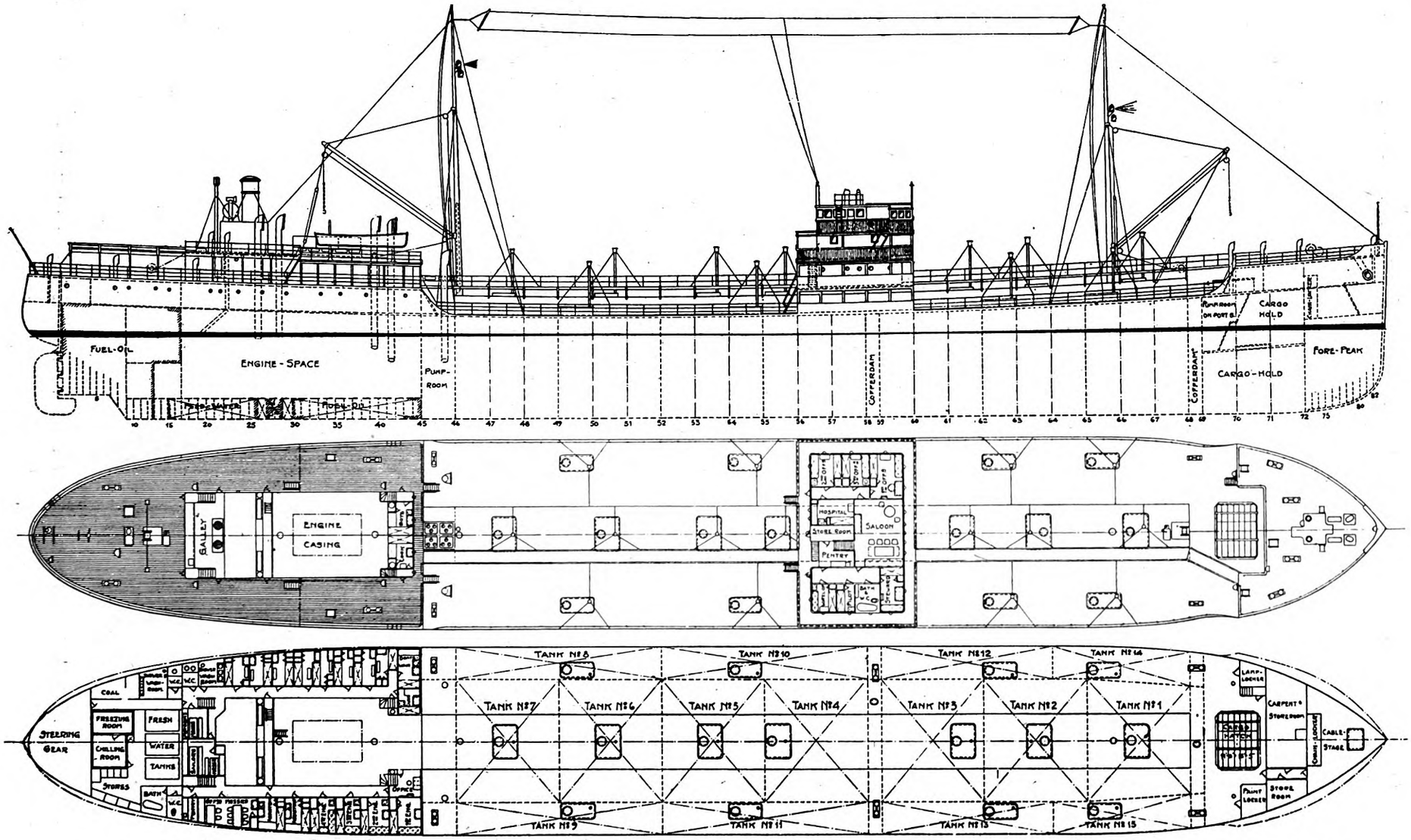

Tank-Motorship Oljaren, of 7,700 Tons Deadweight, Built by Aktiebolaget Götaverken, Göteborg, for the Rederiaktiebolaget Transatlantic, Göteborg, Sweden

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Tank-Motorship Oljaren

General Information

Service: Transportation of oil in bulk.

Builder: Aktiebolaget Götaverken, Göteborg, Sweden.

Owner: Rederiaktiebolaget Transatlantic (The Transatlantic S. S. Co., Ltd.), Göteborg, Sweden.

Characteristics

Length, overall	394′ 3″
Length, B. P.	380′ 3″
Breadth, molded	55′ 0″
Depth, molded	30′ 0″
Draft, loaded	24′ 1¾″
Draft, light	19′ 6″
Block coefficient	0.76
Midship section coefficient	
Longitudinal coefficient	
Speed, loaded, knots	11
Cruising, radius, nautical miles	
Framing	
Class	

Tonnages

(In tons of 2,240 pounds)

*Weight of Hull	
**Weight Propelling Machinery	
Deadweight Capacity	7,700
Displacement	

(In tons of 100 cubic feet)

Gross register	5,481
Net register	3,247

*Weight of Hull includes Hull Proper, Hull Fittings, Equipment, and Outfit.

** Weight of Propelling Machinery includes Engines, Boilers (Wet), Shafting, Propellers, and Machinery Space Auxiliaries.

Canal Ratings

(In tons of 100 cubic feet)

	Gross	Net
Suez	5,547	3,638
Panama	5,634	3,511

Equipment

Anchors

Chains: 2—135 Fathoms, 2 3/16″.

Rudder

Area
Dia. Stock
C. Press. abaft C. L. pintles

Complement

Deck officers	4
Deck crew	13
Engineer officers	5
Engineer crew	9
Purser's and steward's department	
Total officers and crew	31
First-class passengers	1
Second-class passengers	
Third-class passengers	
Total passengers	1
Total complement	32

Handling Equipment

	No.	Type	Capacity	Length
Derrick posts				
Masts	2			
Booms	2		3 & 5 tons	
Discharging Capacity				

Deck Machinery

(Number, Size, Type)

Steering Gear: Electro hydraulic 20 B. H.P. motor—600 r.p.m.
Windlass: 1 electric, 60 H. P.
Capstans
Winches: 2 electric, 3-ton forward, 5-ton aft.

Life Saving Equipment

Lifeboats	No.	Type	Length
Lifeboats	2		25′
Workboat	1		15′ 8″
Workboat	1		15′ 4″

Propelling Machinery

Engines

Number	2
Type	6 cyl. 4 cyc., single acting
Size	bore, 23.2″; stroke, 35.5″
Horsepower, total indicated	2,600

Propellers

Number	2
Type	solid bronze
Weight	
Diameter	10′ 2″
Pitch	9′ 5″
R. P. M.	130
Projected area	
Developed area	

Auxiliary Machinery

(Number, Size, Type)

Machinery Space

3 single acting, 4-cycle, 2-cycle Diesel engines, 75 B. H. P. each.

Air Compressors, 1 electric, 90 H. P.: 1 steam driven.
1 boiler, donkey type, 500 sq. ft., 100 lbs.
1 aux. tank heating, 100 sq. ft. surface.
Pumps:
(2) centrifugal cooling water, elec., 15 H. P., 120 tons per hr.
(2) sets lubricating in pairs, electric, 10 H. P., 18 tons per hr.
(1) oil transfer, electric, 15 H. P., 50 tons per hr.
(1) ballast, electric, 15 H. P., 150 tons per hr.
(2) sets bilge and sanitary, electric; 6.5 H. P.; bilge, each 20 tons per hr.; sanitary, each 15 tons per hr.
(1) donkey pump, 42 tons per hr.
(1) ballast and bilge, electric, 7 H. P., 42 tons per hr.

Cargo Pumps:
(2) centrifugal, each 250 tons per hr., elec. 36 H. P.
(1) drain, electric, 36 H. P., 100 tons per hour.

Refrigerating Machinery

(1) elec. driven CO_2 engine, indirect expansion, 4,000 cal. per hr.

Electric Equipment

Generators: 3—50 K. W., 220 V.
Radio: 1—2.5 K. W. gen., 4 K. W. motor.
Emergency: 1—5.8 K. W. gen., 7 K. W. motor.

Holds

No.	Length	Hatches
1	29′ 6″	1-11′x15′ 5″

Capacity dry cargo:
Lower hold ..... Bales, 14,055 cu. ft.
Grain, 16,210 cu. ft.
Between decks ..... Bales, 17,234 cu. ft.
Grain, 19,247 cu. ft.
Total bales ..... 31,289 cu. ft.
Total grain ..... 35,457 cu. ft.

Capacities

Cargo Space

Compartment
15 oil cargo tanks, capacity oil, $\gamma = 0.87$.

Tank No. 1	883 tons
Tank No. 2	901 tons
Tank No. 3	875 tons
Tank No. 4	857 tons
Tank No. 5	852 tons
Tank No. 6	852 tons
Tank No. 7	860 tons
Tank No. 8	390 tons
Tank No. 9	390 tons
Tank No. 10	398 tons
Tank No. 11	398 tons
Tank No. 12	342 tons
Tank No. 13	342 tons
Tank No. 14	266 tons
Tank No. 15	266 tons
Total	8,872 tons

Refrigerated Space

Compartment	Cu. Ft.
Freezing and chilling room for ship's provisions.	

Bunkers

Fuel and Lubricating Tanks

Compartment	Tons
Aft. peak	399
Inner bottom (engine space)	162
Inner bottom (engine space) Lubr.	14
Total Fuel Oil	561

Tanks

Compartment	Tons
Fore peak (water ballast)	173
Inner bottom (engine space) feed water	40
3 fresh water tanks, total capacity	30
Total	243

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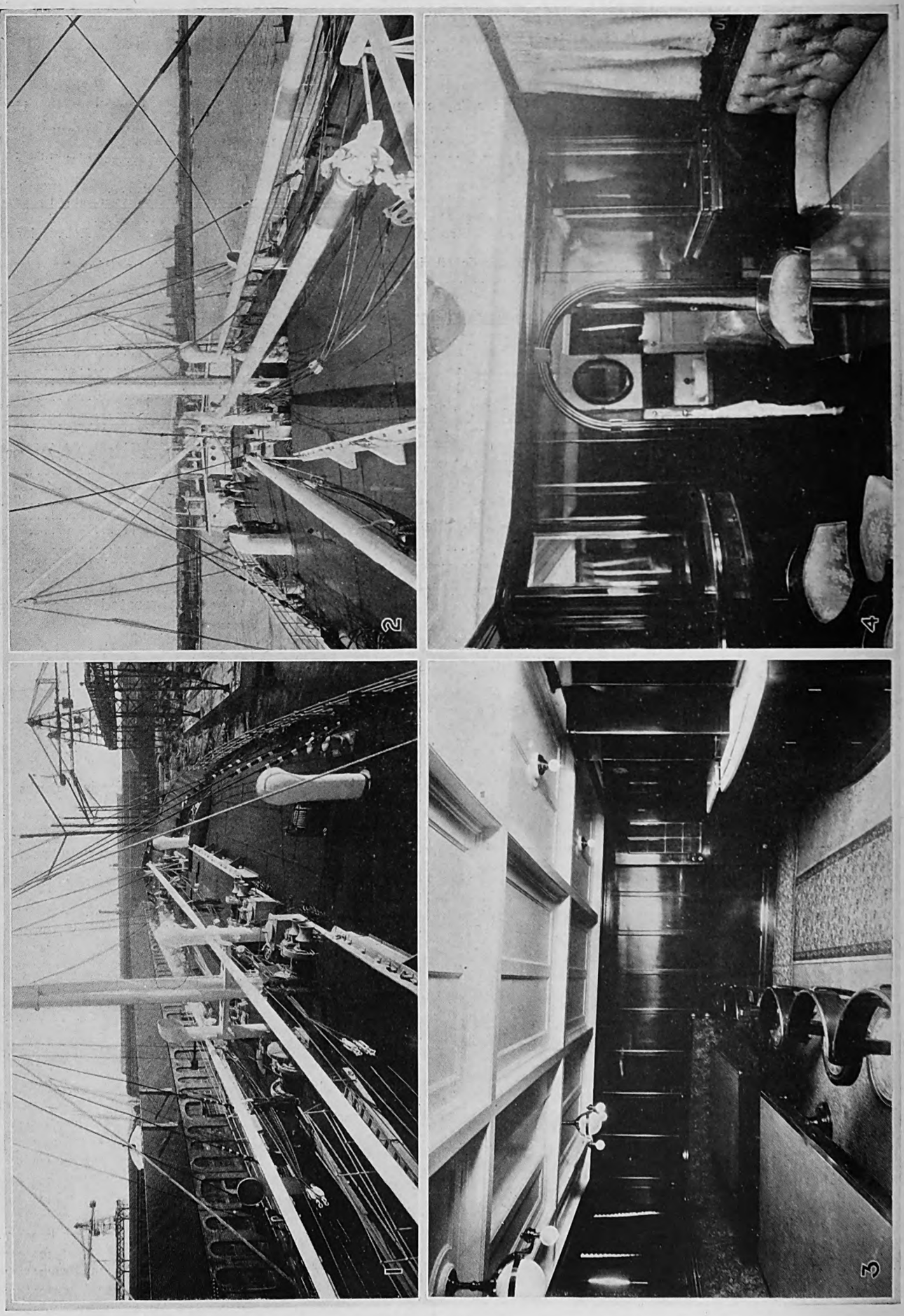

M. S. Tennessee: (1) Deck View, Looking Forward; (2) Deck View, Looking Aft; (3) Saloon; (4) Owner's Suite

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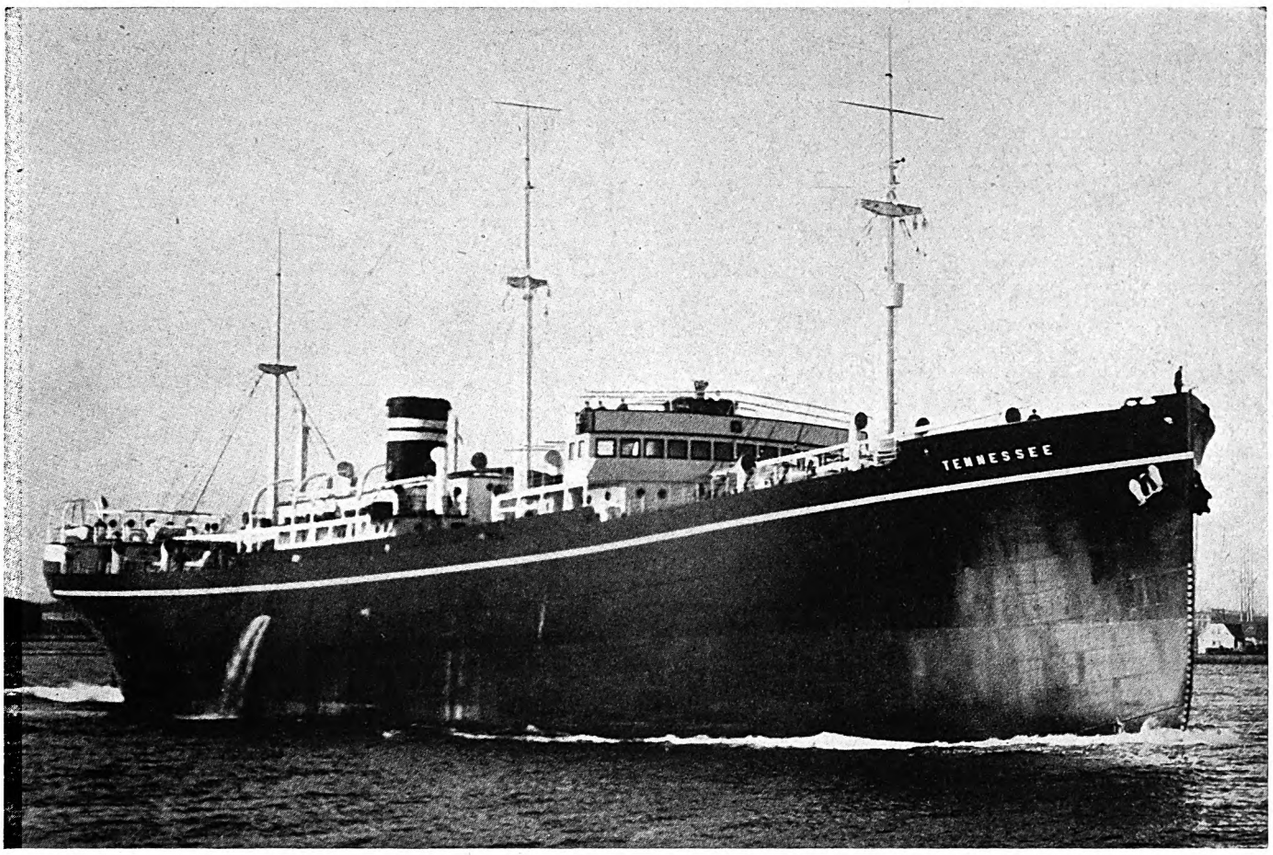

Motorship Tennessee on Trial Trip

Twin-Screw Diesel Motorship Tennessee

Norwegian Motorship of 11,000 Tons Deadweight Capacity Built by Burmeister and Wain for Australian Service

THE twin screw motorship *Tennessee,* just completed by Messrs. Burmeister & Wain, Ltd., Copenhagen, Denmark, to the order of Wilh. Wilhelmsen, Tensberg, Norway, is a sister ship to the *Teneriffa* and *Thalatta,* recently delivered to the same owners. The vessel is specially designed for long voyages, her oil fuel capacity being sufficient for a radius of over 30,000 miles.

The vessel is built to Lloyds Class 100 A1 special survey, awning deck with freeboard and with certificate for carrying oil fuel in the double bottom.

The leading particulars are as follows:

Length overall	444 feet 4 inches
Length between perpendiculars	425 feet 5½ inches
Breadth molded	55 feet 0 inches
Depth molded to awning deck	38 feet 6 inches
Depth molded to upper deck	30 feet 6 inches
Depth molded to lower deck	22 feet 5½ inches
Gross tonnage	7,124
Net register tonnage	4,482
Capacity of holds, about	570,000 cubic feet grain
Oil fuel capacity, about	1,300 tons
Deadweight tonnage, about	11,000
Draft loaded	29 feet 0 inches
Average speed at sea	11½ knots
Normal indicated horsepower	3,100
Normal consumption of fuel oil per 24 hours	10 tons

The hull is subdivided into eight compartments by means of seven watertight bulkheads carried up to the upper deck, there being five cargo holds, three forward of the machinery space and two abaft the machinery space. A double bottom tank extending from peak bulkhead to peak bulkhead is fitted for the carriage of oil fuel or water ballast and in addition a deep tank for oil fuel is fitted between the shaft tunnels in No. 4 hold. The fore peak is arranged for water ballast and the aft peak for fresh water.

The ship has three complete decks of steel supported by a system of girders and wide spaced pillars in the holds, giving a good clear space for the stowage of cargo. The cargo hatches have a width of 18 feet and an average length of about 35 feet.

Cargo Handling Gear

To facilitate the rapid handling of the cargo two steel tube cargo derricks capable of lifting 3 tons in single purchase and 5 tons in double purchase are fitted at each hatchway and in addition thereto there are two 2-ton derricks fitted at No. 4 hatch. For manipulating heavy lifts there is a 25-ton derrick fitted on the foremast at No. 2 hatch and a 10-ton derrick on the mainmast at No. 3 hatch, both arranged for the expeditious handling of heavy shipments.

All the cargo winches are electrically driven and are of Allmänna Svenska Elektriska Aktb. make. There are eight 3-ton winches, two 5-ton winches and two 2-ton winches for working the cargo derricks and also á heavy winch on the

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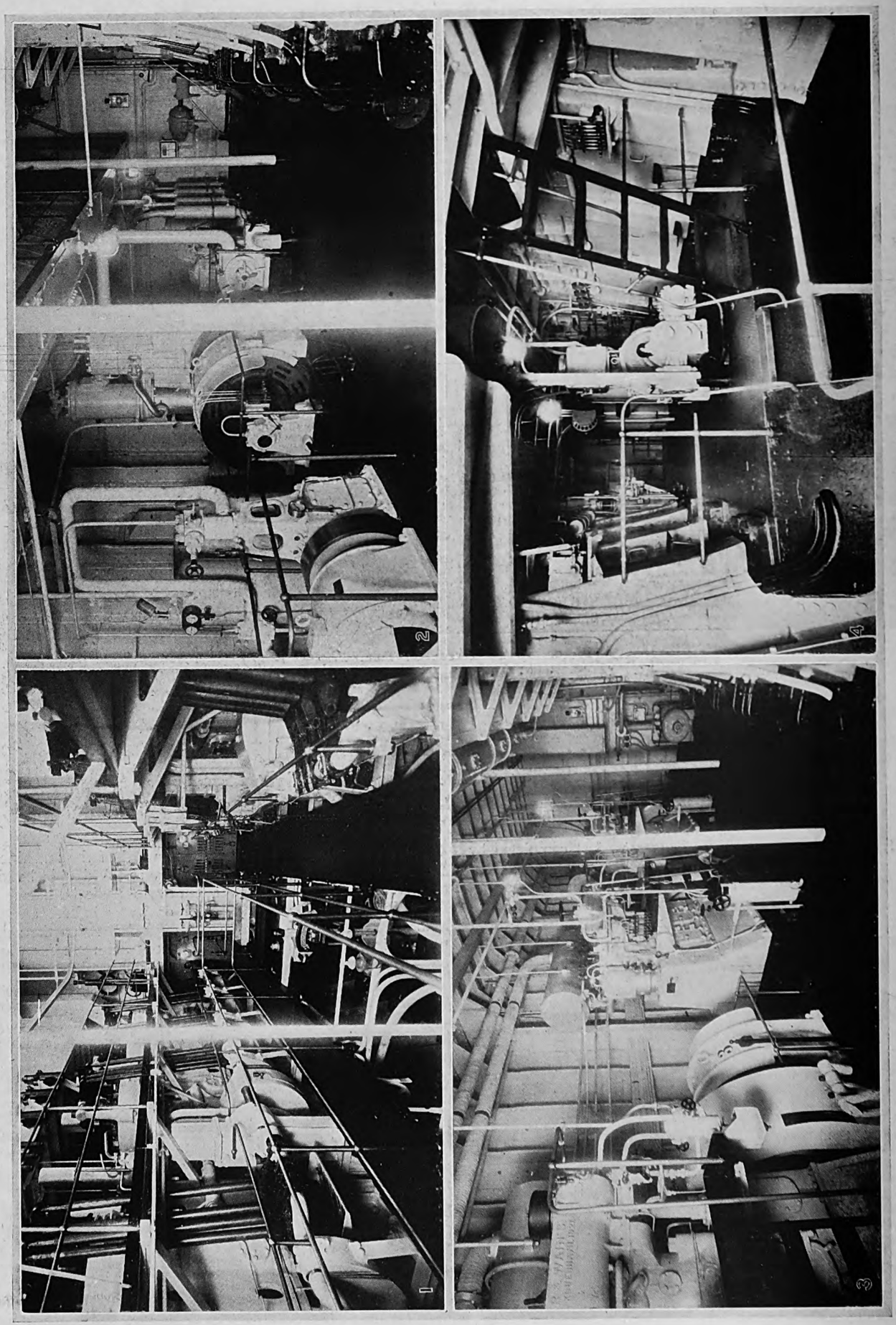

M. S. Tennessee: (1) View of Main Engines from Lower Platform; (2) Starboard Side of Engine Room, Showing Pumps; (3) Port Side of Engine Room, Showing Auxiliary Engines; (4) View Between Main Engines

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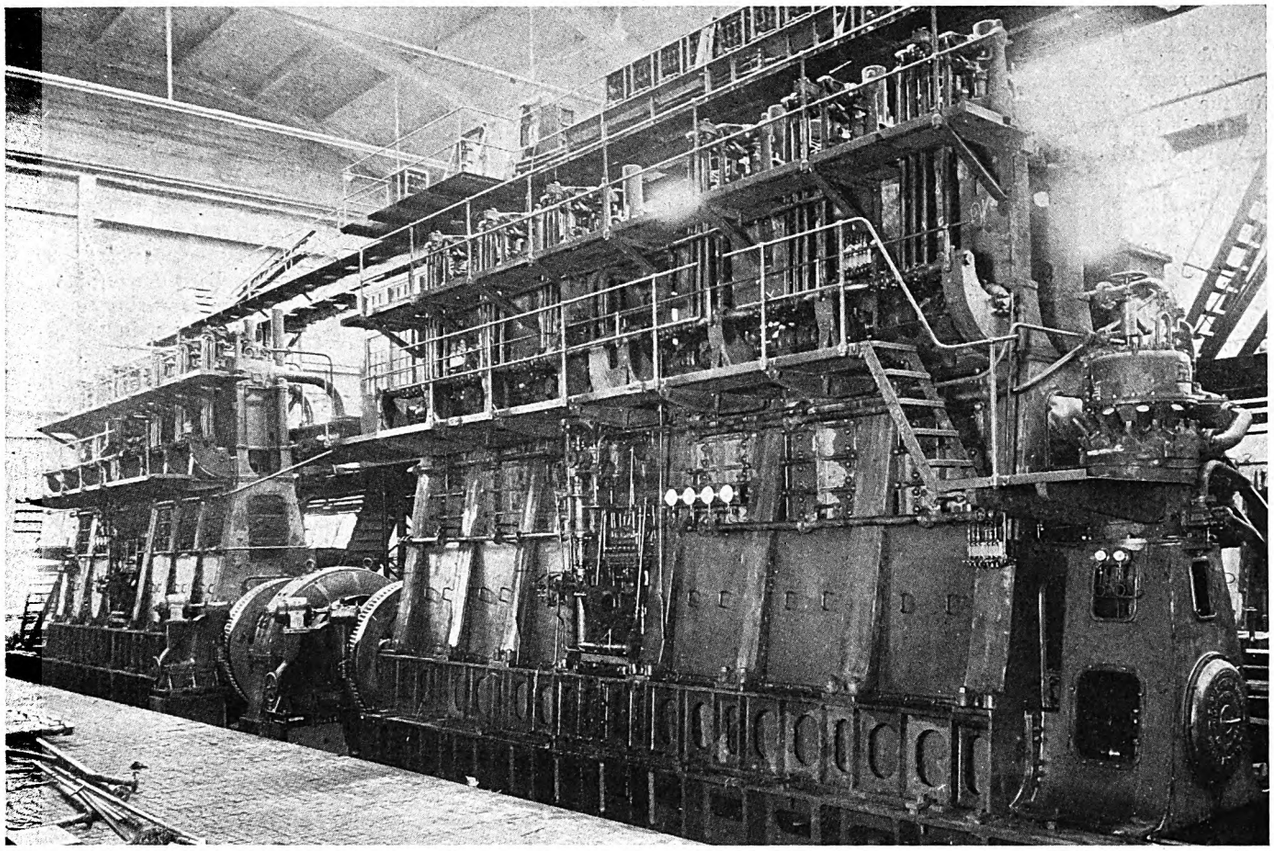
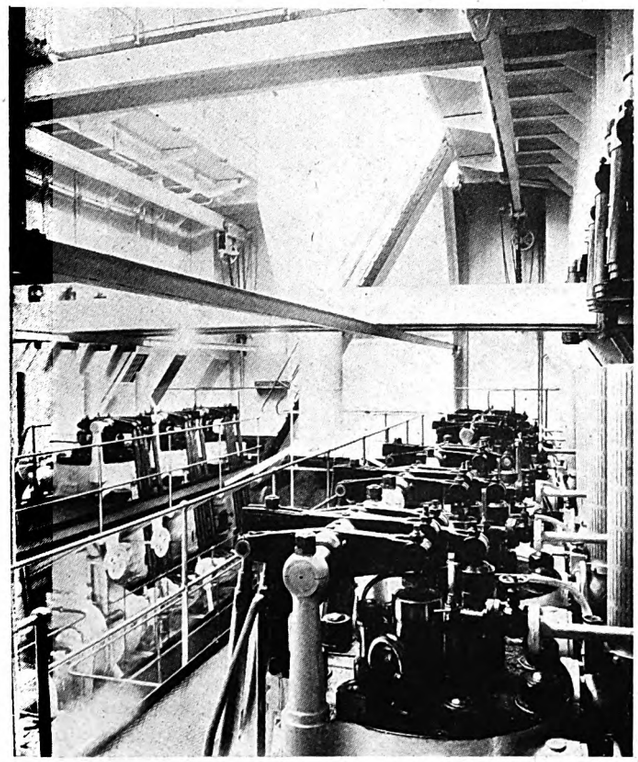


Main Engines of Motorship Tennessee on Test Block

deck aft fitted with extended ends and large warping drums for warping purposes.

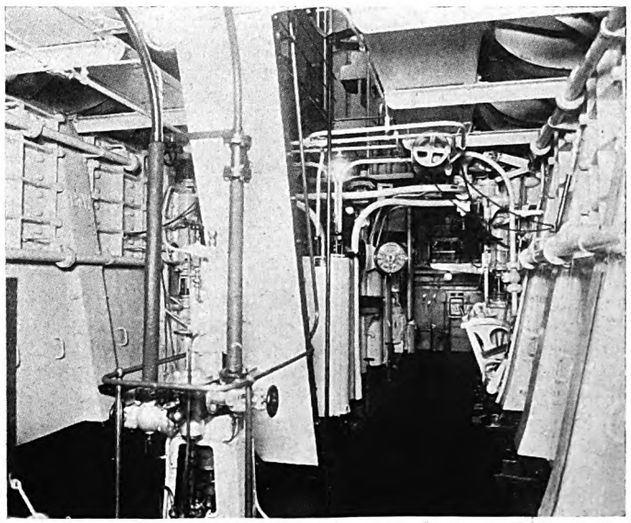


Top of Main Engines

The windlass is of Clarke, Chapman & Company's make, suitable for 2 5/16-inch diameter chain cables and is electrically driven. The steering gear is of the electro-hydraulic Hele Shaw type from Hastie & Company, Greenock, and is controlled from the bridge by means of a telemotor. An emergency steering column is also fitted on the top of the deck house aft.

ACCOMMODATIONS

The saloon is arranged in the foremost deck house and is tastefully fitted out in polished mahogany. There are also four 2-berth passenger cabins excellently fitted out to meet



Maneuvering Platform, Looking Forward

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the requirements in the tropics, likewise a special suite of apartments for the owners' private use.

The captain's accommodation consisting of bedroom and sitting room in polished mahogany is conveniently arranged in the deck house below the commanding bridge. The accommodation for the officers and engineers is fitted in the midship deck house abreast of the motor casing in spacious, well fitted out cabins. The crew are berthed aft, the sleeping accommodation is arranged below the awning deck in well lighted and well ventilated cabins for two men in each, the messrooms being arranged in the deck house above.

A 1¼ kilowatt Marconi wireless telegraph station with accommodation for the wireless operator is fitted in the deck house on the boat deck.

The culinary arrangement is in accordance with the latest practice, refrigerated provision rooms, ice generators, etc., being provided for. Electric light is installed throughout the ship.

A fire extinguishing installation, consisting of the Lux, Ltd., CO_2 system, is fitted with pipe connection to all cargo holds.

Propelling Machinery

The machinery is of Burmeister & Wain's standard type for twin screw ships. The particulars of the main engines are as follows:

2 Burmeister & Wain 4-cycle 6-cylinder Diesel motors.

Diameter of cylinders	630 millimeters
Length of stroke	960 millimeters
Revolutions per minute	125
Indicated horsepower	3,100
Brake horsepower	2,400

The main engines are of the short stroke, forced lubricated crosshead type, with three stage compressors for supplying the necessary injection air for atomizing the fuel oil, fitted at the fore end of the engine.

All auxiliary machinery in the engine room as well as the deck machinery is electrically driven, the necessary current being supplied by three 60-kilowatt Diesel dynamos. The voltage of the current is 220 and for lighting purposes it is transformed down to 110 volts by means of a motor generator.

Each of the generators is sufficient for supplying the necessary current under normal working conditions at sea, whereas two or all three have to be started when maneuvering with the maneuvering compressor running, or when loading or discharging cargo. A small cross tube boiler of about 100 square feet heating surface is fitted for supplying the necessary steam for the steam heating installation in the accommodation.

The trial trip was run on September 28 in the sound at Copenhagen, the following results being obtained:

Mean draft	9 feet 8 inches
Displacement	4,415 tons
Indicated horsepower, average	3,640
Revolutions per minute, average	144
Mean speed	12.6 knots

During the consumption trial, the main engines developed 3,434 indicated horsepower at 137.7 revolutions per minute, on a fuel oil consumption of 0.298 pound per indicated horsepower per hour, the net calorific value being 18,274 British thermal units including the consumption of auxiliary engines producing the necessary current for the auxiliary machinery, steering gear and electric light.

After successfully finishing her trials, the ship returned to the builders' yard to land the officials and trial trip crew and left Copenhagen on the following day on her maiden voyage to Australia.

Supply Ship for Commercial Pacific Cable Company

Staunch Steamer Designed for Continuous Service by Cox and Stevens Is Being Built by the Sun Shipbuilding Company

THE Commercial Pacific Cable Company, of the Mackay system of Commercial Cable-Postal Telegraph, has ordered a steel seagoing cable repairing and supply ship for its Pacific cable service. The vessel, designed by Cox and Stevens, naval architects, New York, is being built by the Sun Shipbuilding Company of Chester, Pa. On completion she will be stationed at Honolulu and used for the transportation of staff, supplies and equipment between the Commercial Pacific Company's station at Honolulu and Midway Island, and also for cable repairing purposes.

This new ship, which is to be named the *Dickenson* and is being built to Lloyd's classification, is of the following dimensions:

Length overall	189 feet, 9 inches
Length on waterline	167 feet, 3 inches
Beam molded	30 feet, 0 inches
Depth molded to shelter deck	22 feet, 6 inches

The vessel is of the shelter deck type, with single screw, with steel deckhouses on the shelter deck, machinery amidships, two pole masts on which steadying sails will be set, elliptical stern and cable ship bow, with the usual appliances for handling the cable forward. As the service in which she will be engaged will mean continuous and extended voyages at sea, particular attention in the design has been paid to seaworthiness and strength of construction. In addition, as the ship will be for the most part used in tropical regions, the accommodations are unusually well arranged as regards roominess and ventilation in order that those on board may be as comfortable as possible under all conditions.

General Arrangement

The general arrangement is as follows: The machinery equipment, consisting of a triple expansion engine with cylinders 17 inches, 25 inches and 43 inches diameter and stroke of 30 inches, supplied with steam by two Scotch boilers 12 feet diameter and 11 feet long, is located slightly aft of amidships. Forward of the boiler space are the fuel oil bunkers, which are extremely large permitting an unusual steaming radius, there being in addition reserve fuel oil bunkers at the after end of the machinery space so that the ship may be properly trimmed in all conditions of loading. At the extreme after end of the vessel is an after peak tank, there being in addition a fore peak tank, as well as tankage for boiler feed and water ballast in the hold.

The rudder stock is carried straight up to the boat deck, with independent hand steering gear, the quadrant and the steam steering engine being located below deck.

Forward of the machinery space there is provided an unusually large cold storage compartment properly subdivided, forward of this again in the hold is a cable tank as well as provision for stowage of dry stores.

On the upper deck at the after end is the main dining saloon, as well as living quarters for the engineer, officers, steward and pantry attendants. Abreast the machinery space

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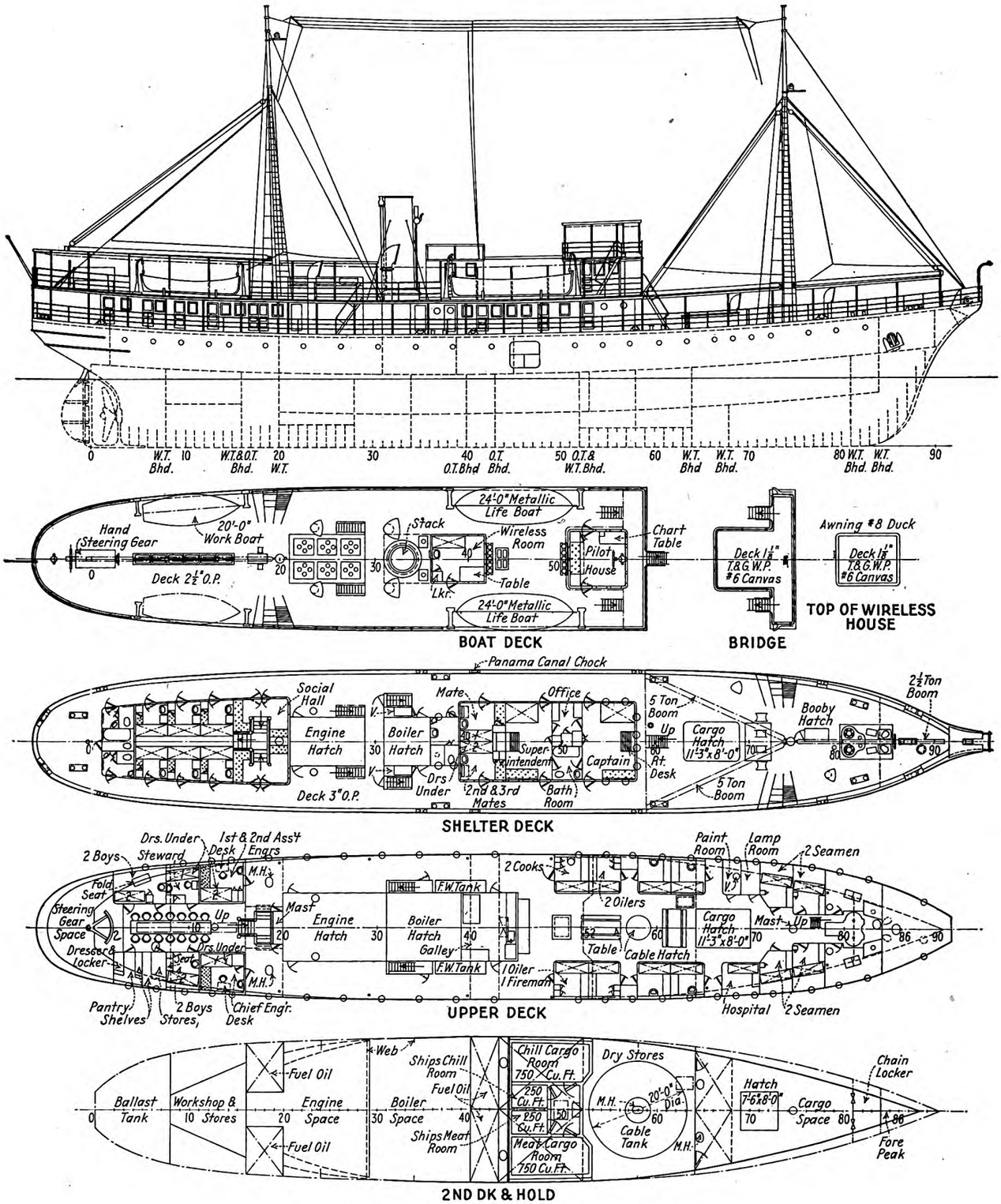

Profile and Deck Plans of Cable Supply Ship

on this deck there is a very considerable cargo space which can be served by two cargo side ports located about amidships. The space on the upper deck forward of amidships is laid out to provide living quarters for the crew, these being all in separate rooms, each having accommodations for two men, there being in addition ample facilities in the way of wash rooms, toilets, etc., as well as a hospital.

On the shelter deck there are two steel houses, the one aft of the machinery space containing a social hall and six double-bedded staterooms with necessary bathrooms for use of passengers. The house forward of the machinery space contains quarters for the captain and deck officers, as well as for the superintendent of the company.

On the boat deck there is at the forward end a pilot house

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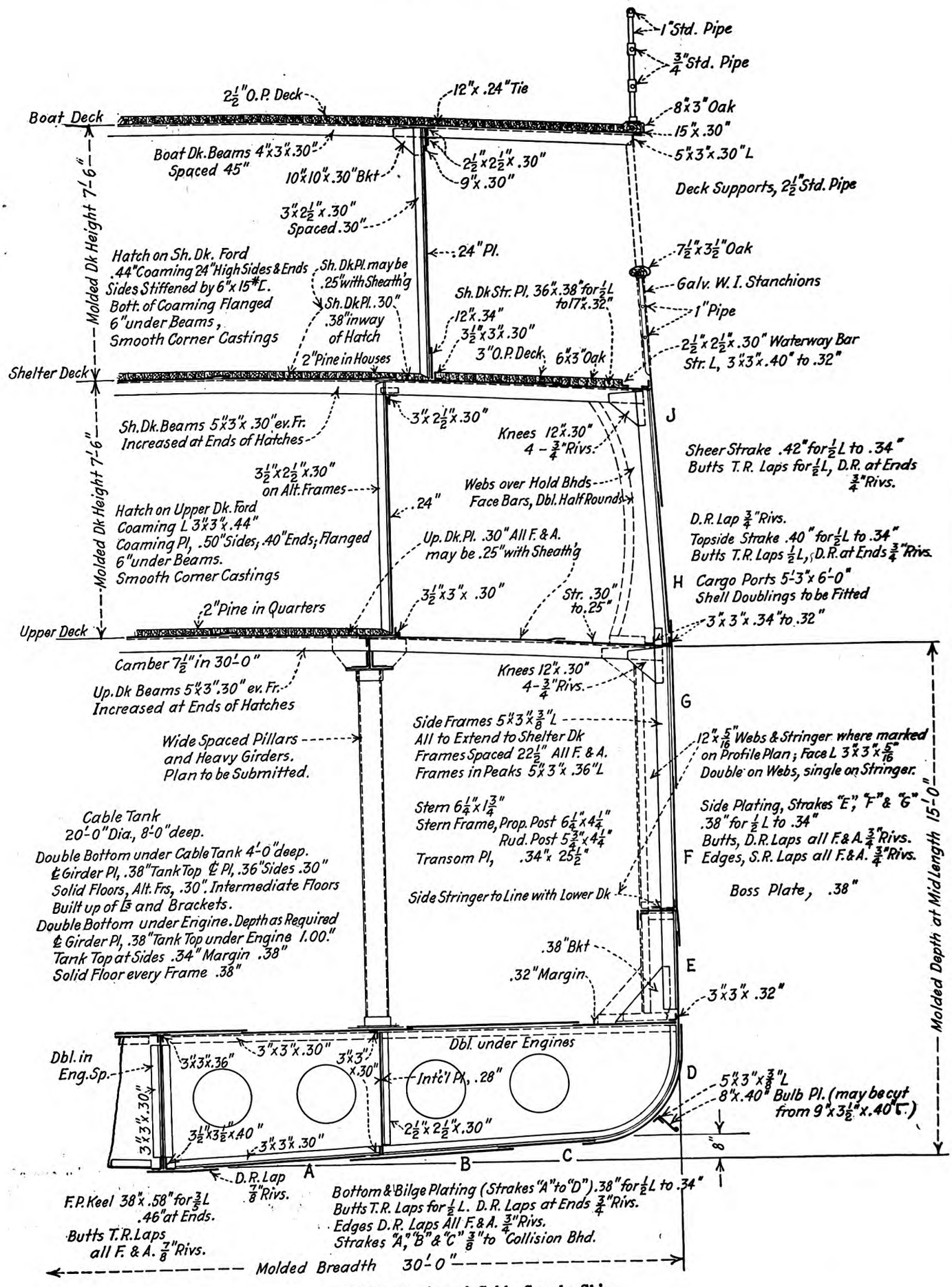
1"Std. Pipe
¾"Std. Pipe
2½"O.P. Deck
12"x .24"Tie
Boat Deck
8"x3"Oak
15"x.30"
5"x3"x.30"L
Boat Dk.Beams 4"x3"x.30" Spaced 45"
10"x10"x.30"Bkt
2½"x2½"x.30"
9"x.30"
Deck Supports, 2½"Std. Pipe
3"x2½"x.30" Spaced .30"
Molded Dk Height 7'-6"
Hatch on Sh. Dk. Ford .44"Coaming 24"High Sides & Ends Sides Stiffened by 6"x15#L. Bott. of Coaming Flanged 6"under Beams, Smooth Corner Castings
Sh. Dk Pl. may be .25"with Sheath'g
Sh. Dk Pl. .30" .38"inway of Hatch
24" Pl.
7½"x3½"Oak
Galv. W. I. Stanchions
Sh. Dk Str. Pl. 36"x.38"for ½L to17"x.32"
12"x.34"
3½"x3"x.30"
1"Pipe
2"Pine in Houses
3"O.P. Deck
6"x3"Oak
2½"x2½"x.30" Waterway Bar Str. L, 3"x3"x.40" to .32"
Shelter Deck
Molded Dk Height 7'-6"
3"x2½"x.30"
J
Sh. Dk. Beams 5"x3"x.30" ev. Fr. Increased at Ends of Hatches
Knees 12"x.30" 4-¾"Rivs.
Sheer Strake .42"for ½L to .34" Butts T.R. Laps for ½L, D.R. at Ends ¾"Rivs.
3½"x2½"x.30" on Alt. Frames
Webs over Hold Bhds Face Bars, Dbl. Half Rounds
24"
Hatch on Upper Dk. Ford Coaming L 3"x3"x.44" Coaming Pl, .50"Sides, .40"Ends; Flanged 6"under Beams. Smooth Corner Castings
Up. Dk. Pl. .30" All F. & A. may be .25" with Sheath'g
D.R. Lap ¾"Rivs. Topside Strake .40" for ½L to .34" Butts T.R. Laps ½L, D.R. at Ends ¾"Rivs.
3½"x3"x .30"
Str. .30" to .25"
H Cargo Ports 5'-3"x 6'-0" Shell Doublings to be Fitted
2"Pine in Quarters
Upper Deck
3"x3"x.34"to.32"
Camber 7½"in 30'-0"
Knees 12"x.30" 4-¾"Rivs.
Up. Dk Beams 5"x3".30" ev. Fr. Increased at Ends of Hatches
G
Side Frames 5"x3"x⅜"L All to Extend to Shelter Dk Frames Spaced 22½" All F. & A. Frames in Peaks 5"x3"x.36"L
12"x5/16" Webs & Stringer where marked on Profile Plan; Face L 3"x3"x5/16" Double on Webs, single on Stringer.
Wide Spaced Pillars and Heavy Girders. Plan to be Submitted.
Cable Tank 20'-0"Dia., 8'-0"deep.
Double Bottom under Cable Tank 4'-0"deep. ℄ Girder Pl, .38"Tank Top ℄ Pl, .36"Sides .30" Solid Floors, Alt. Frs, .30". Intermediate Floors Built up of L's and Brackets.
Double Bottom under Engine. Depth as Required ℄ Girder Pl, .38"Tank Top under Engine 1.00" Tank Top at Sides .34" Margin .38" Solid Floor every Frame .38"
Stem 6¼"x1¾"
Stern Frame, Prop. Post 6¼"x4¼" Rud. Post 5¾"x4¼"
Transom Pl, .34"x 25½"
Side Plating, Strakes "E", "F" & "G" .38"for ½L to .34" Butts, D.R. Laps all F.& A. ¾"Rivs. F Edges, S.R. Laps all F.& A. ¾"Rivs.
Boss Plate, .38"
Side Stringer to Line with Lower Dk
Molded Depth at Midlength 15'-0"
.38"Bkt
.32"Margin
E
3"x3"x.32"
Dbl. in Eng. Sp.
3"x3"x.36"
3"x3"x.30"
3"x3"x.30"
Dbl. under Engines
Intc'l Pl, .28"
D
5"x3"x⅜"L
8"x.40" Bulb Pl. (may be cut from 9"x3½"x.40"L.)
3"x3"x.30"
3½"x3½"x.40"
3"x3"x.30"
2½"x2½"x.30"
8"
A
B
C
D.R. Lap ⅞"Rivs.
F.P. Keel 38"x.58"for ¾L .46"at Ends.
Butts T.R. Laps all F. & A. ⅞"Rivs.
Bottom & Bilge Plating (Strakes "A" to "D") .38"for ½L to .34" Butts T.R. Laps for ½L. D.R. Laps at Ends ¾"Rivs. Edges D.R. Laps All F. & A. ¾"Rivs. Strakes "A", "B" & "C" ⅞"to Collision Bhd.
Molded Breadth 30'-0"

Midship Section of Cable Supply Ship

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with sleeping accommodations for the pilot, and also a wireless room containing wireless apparatus and bunk for the wireless operator.

The specifications for this vessel are extremely complete and call for the most modern type of equipment and auxiliaries. The ice machine is of the York Manufacturing Company's make, operating on CO_2 gas with brine circulation. The oil burning equipment is of the Dahl type, which is used largely on the Pacific Coast and has proven extremely satisfactory.

The vessel will be heated throughout by steam and lighted by electricity, special attention being given to securing forced ventilation in quarters as well as the best possible system of natural ventilation.

Floating Dry Dock Navigated Carrying 13,000-Ton Vessel

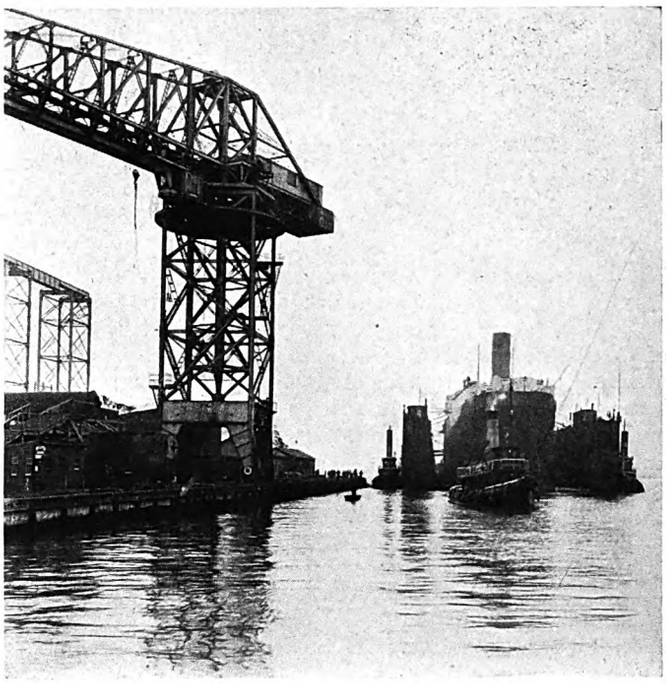
ON November 11, at Chester, Pa., the oil tanker *J. N. Pew* while on the dry dock of the Sun Shipbuilding Company was very seriously damaged, by the explosion of oil gas while repairs were being made upon the tanks.

The accident resulted in the loss of life of one man and the injury of 18 others, and very seriously damaged the ship, so much so, that she could not be floated off the dry dock until very extensive repairs, including the removal of interior machinery and parts, were effected.

As this company has a large hammer head crane in connection with its shipbuilding plant, the question was raised as to whether it would be possible to move the ship and dock from the berth out into the Delaware River, tow the vessel and dock some little distance up stream and place them together under the derrick.

As the local underwriters were somewhat doubtful as to this unusual suggestion, the designer of the dry dock, William T. Donnelly, consulting engineer, New York, was called on the long distance telephone in New York, and unhesitatingly assumed all responsibility, with the result, as shown in the illustrations, that the dock and ship together handled by a fleet of seven tugs was moved under the crane and returned to its mooring without difficulty.

This is believed to be the first time that such a vessel as large as 13,000 tons deadweight has been navigated on the deck of a floating dry dock.

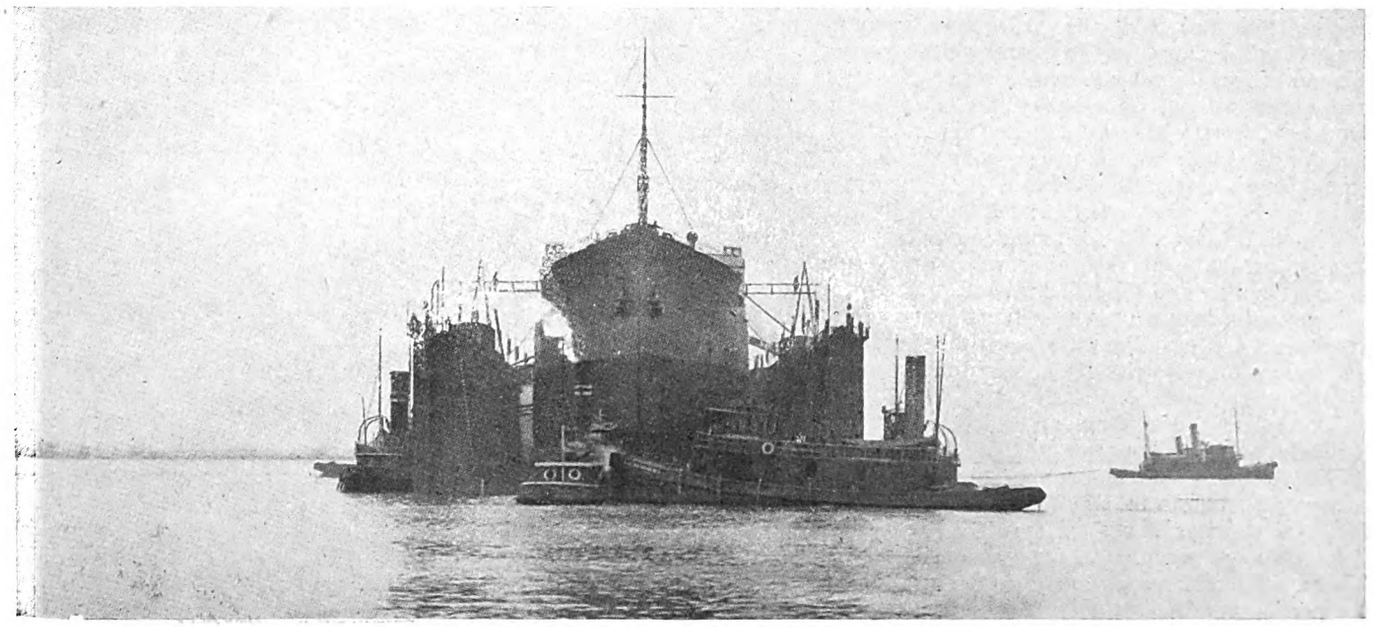


Bringing Floating Dry Dock and Damaged Vessel Under Hammerhead Crane at the Sun Yard

It might be added, on the designer's authority, that the stability of ship and dock was very much greater than that of the ship when floating at her usual waterline.

SYSTEM FOR NUMBERING OF STEELS.—A system of designating kinds or qualities of steel by code numbers, each of which would represent a definite specification, will be developed as a result of a recent conference of the principal producers and users of steel held at Washington, D. C., at the call of the American Engineering Standards Committee.

INSTITUTION OF NAVAL ARCHITECTS.—The spring meeting of the Institution of Naval Architects will be opened in London on Wednesday, March 21.



Floating Dry Dock Being Towed up the Delaware River with a 13,000-Ton Vessel on Board

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Stern Wheel Western River Towboat Wacouta

Steel Hull Is Stayed by Girders Instead of Hog Chains—Propulsion Is by Twin Tandem Compound Condensing Engines

By T. R. Tarn

THE stern wheel river towboat *Wacouta,* built for the Joyce-Watkins Company, by the Dravo Contracting Company, Pittsburgh, Pa., and designed by the firm of Cox & Stevens, New York, has just been delivered to her owners after a very satisfactory trial trip at Pittsburgh. The home port of the *Wacouta* will be Paducah, Ky. She will operate out of that place to tow railroad ties on the Cumberland and Tennessee Rivers.

The principal dimensions of the vessel are as follows:

Length overall	157 feet	4⅞ inches
Length on deck	134 feet	5⅛ inches
Beam, molded	28 feet	0 inches
Beam, overall	28 feet	8⅝ inches
Depth, molded	5 feet	0 inches
Crown of deck		6 inches
Mean draft		47 inches

The design of this boat includes all of those features found on the boats operating in the Monongahela River pools with

Shallow Draft Ohio River Towboat Wacouta

such modifications as were necessary to adapt her to service on the Tennessee and Cumberland Rivers.

Hull Construction

The steel hull is of the girder type having a modified scow bow, designed so as to permit of carrying a large amount of fuel, in order to make a trip to Sheffield, Alabama, and return without refueling. This bow, like the ordinary scow bow, is very easy to plate and gives a substantial seating for the deck fittings and towing knees. The hull is strengthened longitudinally below deck by five trusses and transversely by five watertight bulkheads.

The steel deck on the forecastle and guards is covered with Oregon fir. The planksheer is white oak. In the way of the coal bunker and the boilers the deck is cemented.

Two main deck trusses seat directly over the wing trusses in the hull and continue aft to form the support of the wheel and transmit the stresses due to operation, in conjunction with the cylinder beams.

The cylinder beams are built of plates and angles with a single web and conform to the crown and sheer of the deck. At the after transom the long beams jog to the bottom of the transom to give a greater depth to the beam and facilitate in transferring the dynamic stresses into the hull.

Recesses are provided in the cylinder beams for the pillow blocks. The after ends are fitted with a jockey beam and the portions of the main deck trusses extending aft of the splash bulkhead are stiffened by struts connected to the center ridge stringer at the boiler deck.

The main deck house and the boiler deck are of steel construction. The sides of the house forward of the main engines are formed as a part of the main deck trusses. The side capstans are located in recesses built in the sides of the house. Provision has been made for coaling the bunker from fuel flats through side doors in the house as well as from chutes or cranes from overhead. A coaming extending around the head of the boat together with inboard coamings are fitted to carry coal on the boiler deck to supplement the main bunker supply.

All of the weather plating on the boiler deck is 3/16-inch thick. The plating inside of the quarters is No. 14 gage with 2-inch by 1¾-inch nailing strips placed on every beam to receive ⅞-inch tongue and groove maple flooring.

The frame of the cabin and the hurricane deck are of wood construction. Siding panels of 5/16-inch "Neva-Split" material is used. The overhang of the hurricane deck is supported by 1¼-inch galvanized pipe stanchions forming the boiler deck rail.

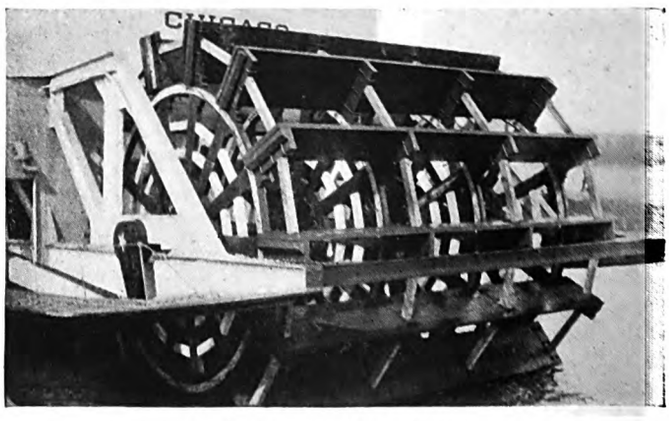
The pilot house is of steel construction, 12 feet by 15 feet in size. The after end extends over the entrance hall to the quarters forming a seat. The steering apparatus and other gear underneath the pilot house is enclosed by a bulkhead and the remaining space is an officers' wash room.

The officers' and crew's quarters are sheathed under the carlins with stamped metal ceiling. Ventilation is provided by means of transoms under deck, both inboard and outboard. Screen doors, transom sash screens, steam heat, hot and cold filtered water for the plumbing, running ice water for drinking purposes and electric lights have been provided.

Propelling Machinery

The propelling machinery is of the twin tandem compound condensing type with cylinders 12 inches by 26 inches by 6 feet stroke operating with a steam pressure of 200 pounds per square inch. The machinery was built by the James Rees and Sons Company, Pittsburgh, Pa. The valves on both the high and low pressure cylinders are of the balanced poppet type operated by an "inside cam" motion. The "Rees" adjustable cut-off is fitted to the high pressure cylinders. The low pressure cylinders operate full stroke at all times.

Steam reversing gear is fitted together with cylinders to raise the levers and do the necessary cushioning.



Radial Stern Paddle Wheel

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The wheel is 18 feet in diameter by 18 feet long with 14 buckets each 30 inches wide. The wheel shaft is a solid nickel steel forging hexagonal in section 10½ inches across the flats with 4 cast steel flanges secured to the shaft by wedges. The journals are 10 inches in diameter by 10 inches long. The cranks are open hearth steel forgings, machined all over, and shrunk on the shaft.

BOILERS

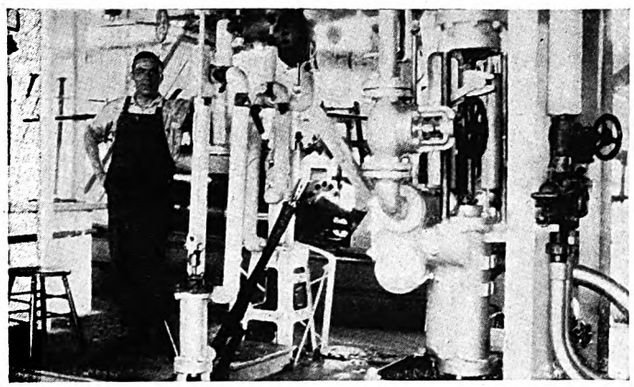
The boilers consist of three units in one battery, 40 inches in diameter by 24 feet long, each containing five 9-inch flues of lap welded tubing. They are arranged for burning coal, hand fired, with natural draft. They are equipped with Snowden heaters, Van Dusen water gages and steam jet blowers. The safety valves are of the spring loaded type with the vents carried to the top of the pilot house.

The auxiliary boiler located in the engine room is 48 inches in diameter by 7 feet high, designed for a steam pressure of 200 pounds per square inch.

AUXILIARIES

The condenser, built by Row & Davis, is circular in section of steel plate containing 900 square feet of cooling surface. The tubes are ¾ inch in diameter of Admiralty mixture, not tinned, No. 18 B. W. G. The discharge from the condenser is run to the ash pan and discharges through the ash well.

The air pump is an independent, vertical twin beam pump having the air cylinders 14 inches in diameter, steam cylinder



Operating Platform, Looking to Port

8 inches in diameter, all with a common stroke of 12 inches.

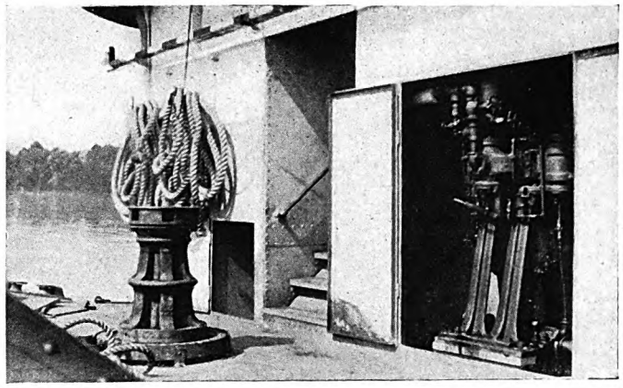
The circulating pump is of the centrifugal type with a side inlet, receiving its suction from the cold well. It is direct connected to a 6-inch by 6-inch vertical engine mounted on the same bed plate. The pump suction is 8 inches and the discharge 6 inches.

There are two boiler feed pumps of the vertical simplex extra heavy Worthington type with 5-inch water cylinders, 7½-inch steam cylinders, with a common stroke of 12 inches. These pumps are controlled by chronometer valves operated by a float in the hot well to maintain a constant level of water in the closed feed water system.

The sanitary pump is a horizontal duplex piston pump of the Worthington type with steam cylinders 5¼ inches in diameter, water cylinders 4¾ inches in diameter, with a common stroke of 5 inches.

The heater is of the Row & Davis, horizontal, steel shell, single pass, pressure type capable of heating 12,000 pounds of water when furnished with exhaust steam at 6 pounds back pressure.

The cold well is made of 3/16-inch copper, 30 inches in diameter, extending above the main deck. It is connected to combination cast brass shoes and strainers fitted to the side plating by 10-inch galvanized intake pipes. Quick opening steam scavaging pipes and quick opening gate valves, both operated from the engine room, are fitted at the intakes.



Bow Capstan and Capstan Engine

The hot well is built of 3/16-inch steel plates, 4 feet long by 2½ feet wide by 3 feet deep, divided into four compartments by baffle plates forming skimming and quieting chambers.

Two 24-inch cast iron, tandem, double combination sand and charcoal pressure filters of the Scaife type are installed as part of the plumbing system, together with a coagulating device for introducing alum into the water. In connection with the filters a softened water tank built of 3/16-inch steel plate is installed in the engine room to provide make-up feed water storage for the boilers. The level of the water in this tank is automatically maintained and is introduced into the feed water system ahead of the air pump.

A hot water heater of the Row & Davis "Paracoil" type is installed as part of the plumbing system. This heater is capable of heating 500 gallons per hour from exhaust steam at 6 pounds gage pressure. This heater is independent of the water back in the galley stove and hot water storage tank in the galley.

The steering gear is of the regular Western River ram type, 7 inches in diameter, installed under the boiler deck over the long tiller. The pilot wheel is 10 feet in diameter and the tiller lines ¾ inch in diameter.

The electrical generating equipment consists of a 15 kilowatt, 125 volt, direct current Engberg unit, vertical enclosed engine direct connected to the generator, and a 1-kilowatt, 110-volt, direct current Moon turbine unit for standby service. An arc searchlight and a 1,000-watt nitrogen filled lamp projector, both controlled from the pilot house, are installed on the forward end of the boiler deck. At the splash bulkhead a "landing light" controlled from the pilot house is installed both port and starboard.

The steam capstan on the forecastle is of the double drum, double purchase type with wood filled barrel operated by a double reversing 6-inch by 8-inch engine, located on the main deck. The side capstans have single cast iron barrels and are operated, single purchase, by double reversing 5-inch by 7-inch engines located below deck.

The refrigerating machine is of the direct expansion ammonia marine type having a capacity of one ton. The refrigerator, located on the boiler deck, contains a 40-pound ice-making set and a scuttle butt with drinking fountains located in the dining and engine rooms.

To comply with the Interstate Guarantee Regulations a "Polarstil" as manufactured by the Jewell Polar Company, having a capacity of 15 gallons per hour and a storage capacity of 200 gallons was installed.

The main steam line is 4½ inches in diameter and the branch steam lines 3 inches in diameter. The main engine throttle is of the quick-opening type located under the boiler deck to eliminate the usual spring and branch pipe bends.

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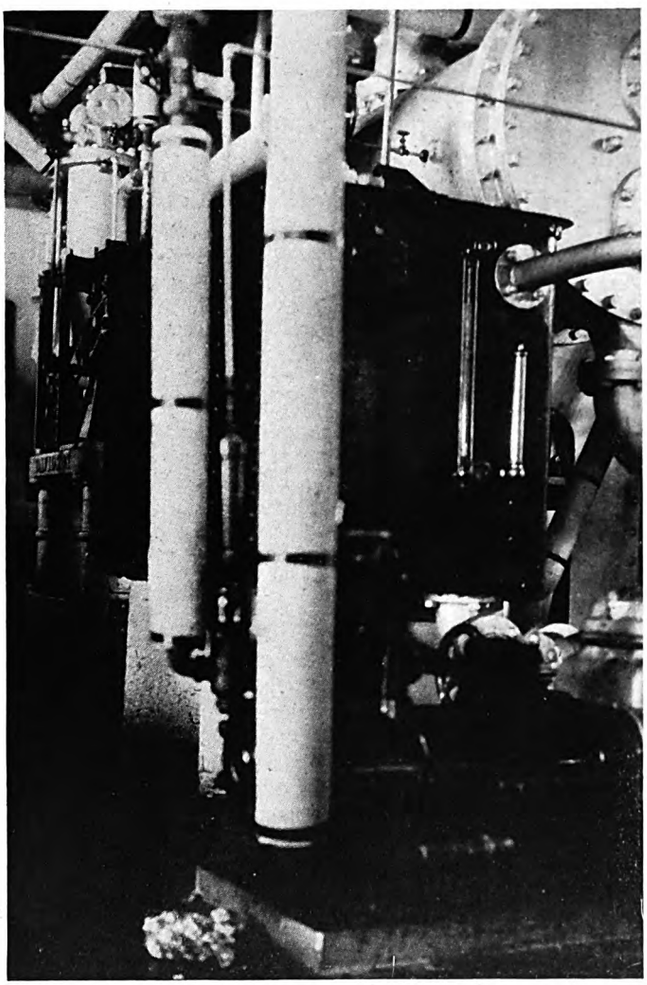
It is operated by means of levers and rods from a graduated quadrant on deck.

The auxiliary steam line is 3 inches in diameter, furnishing steam to the auxiliaries through a reducing valve at 125 pounds pressure.

Boiler pressure is used for the boiler feed pumps, injector, steering gear, whistle, portable syphons and the capstan engines. Auxiliary steam line pressure is used on all other units including the hull syphons.

Provision has been made at the forecastle for steam connections for attaching portable steam syphons for unwatering



View Showing Hot Well Air Pump, Sanitary Pump and End of Condenser

the barges. Plug receptacles for attaching electric cables for use in connection with portable motor-driven centrifugal pumps have also been provided.

Mr. W. W. Watkins, general manager of the River Transportation Department of the Joyce-Watkins Company, has conducted a series of tests with several pumps of this type in order to effect a saving in the amount of raw river water required for make-up feed purposes. Unfortunately, an improved pump devised by Mr. Watkins was destroyed in the recent Chicago fire.

All of the auxiliaries in the engine room, as well as the capstan engines, exhaust into a common header. An automatic back pressure valve maintains a constant pressure of 6 pounds on this line and allows the surplus exhaust steam to enter the condenser. With this arrangement of piping the amount of make-up water for the boilers is minimized and a greater overall economy is obtained. An outboard relief valve is installed on this line as well as an atmospheric exhaust line to the paddle wheel for melting ice and to permit of operating the main engines non-condensing should occasion require.

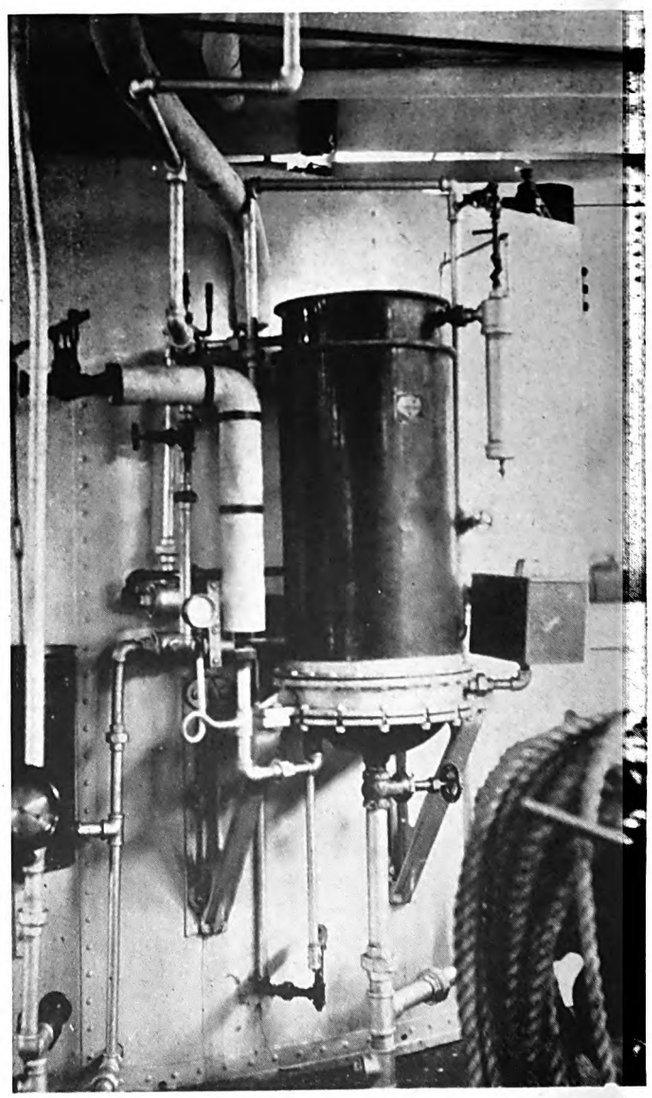
Outfit, Fittings and Equipment

The electrical installation includes plug receptacles for attaching portable hand lamps in the way of the boilers, machinery and wheel and outlets for fans and the electric iron in the laundry.

The plumbing fixtures are modern in every respect and were selected with the object of providing the crew with conveniences similar to those found ashore. All lavatories, sinks, tubs and showers are supplied with a plentiful supply of hot and cold filtered water with provision for supplying the same at all times.

Cast iron radiation is used for steam heating and is installed in the pilot house, all toilet rooms, the dining room and the forward and after cabin halls. The steam supply is taken from the main exhaust header ordinarily, with provision for using live steam if desired.

All bitts, chocks and cavils are of cast iron. The bitts are 8 inches in diameter. The chocks have 6-inch rollers and the quarter chocks and those in the way of the side capstans are tilted to give fair leads to the capstan barrels. Shackled fastenings for towing chains have been provided.



Distiller for Fresh Drinking Water

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Two 16-foot wooden yawls are provided. Rollers made of 2-inch pipe are fitted at the guard and in the deck room to facilitate stowing the yawls in the deck room when desired.

The berths for the officers and crew are of white enamel steel pipe with wire springs secured in metal frames. A double berth has been fitted in the engine room aft of the tiller bulkhead for the firemen or for use as a spare berth.

The usual engine room signal bells are installed with a jingle bell in the firing alley, as well as a chestnut bell in the engine room. Cory and Sons system of engine telegraphs have been installed to supplement the above.

A combination oil and lamp locker is built in the deck room as part of the engine room bulkhead. This location does away with handling the oil in the engine room and confines a fire possibility to a more desirable place.

A very substantial locker built of steel has been provided for the engineer. A complete equipment of tools and spare parts has been provided to enable the engine room crew to make temporary or minor repairs.

Special attention has been given to the painting. The interior of the hull has been painted white in order to take as much advantage as possible of reflection. The interior of the main deck house and engine room have a finishing coat of spar varnish. The machinery, in addition to the usual foundry filler, was given a heavy coat of lead and oil after erection and then varnished. Those parts subjected to high temperatures and not covered were given a coat of aluminum paint.

A recording pressure gage was installed on the main steam line and a recording temperature gage on the boiler feed line. A revolution counter was also installed.

The installation of superheaters was considered but the installation will not be made at present.

This machinery develops 450 indicated horsepower under ordinary service conditions when towing four wooden barges 135 feet by 26 feet when loaded to a draft of 7 feet when the river is at an ordinary stage.

The stresses in the hull structure were carefully determined by plotting the curves of weight, load, buoyancy and sheer in order to determine the maximum bending moment and its location, to effect as much saving in steel material as possible, consistent with a satisfactory fiber stress. This is a rather unusual procedure in river practice but a necessary one, especially in a shallow hull of this kind where the stresses are taken care of by trusses rather than by the usual method of hog-chaining.

Shipping Board Teaching Principles of Efficient and Economical Fuel Combustion at Navy Testing Plant

Great Competition Shown on Part of Engineers Taking Course to Obtain the Honors for Best CO_2 Readings

THE marine world has not appreciated the importance of high boiler efficiency to the same extent as have the operators of large sized stationary plants. On page 100 is given a chart showing the saving accomplished by applying stationary practice to several vessels which are representative types of the Shipping Board fleet.

The average CO_2 conditions that were found on the 13 vessels, as shown on the chart, gave 8.9 percent which shows a loss of fuel of over 6 percent. For example, if the 13 vessels had an average fuel consumption of 200 barrels per day with 150 steaming days per year, the saving would be $36,000 in one year.

The Fuel Conservation Committee of the United States Shipping Board appreciates this situation and as part of its program has instituted the Fuel Oil School at the Philadelphia Navy Yard for engineer officers of the merchant marine. The school is located at the Fuel Oil Test Plant of the Philadelphia Navy Yard and is under the direct supervision of the Navy personnel. Lieutenant Commander H. H. Norton is in charge and has very able assistants to help him carry out this work.

The Fuel Oil Test Plant is the best of its kind in the country. It has several different kinds of boilers and every means for obtaining the most complete data on steam boiler efficiencies.

SUBJECTS COVERED

One of the subjects covered in this five-day course is the problem of combustion. In order to give the engineer the principles on which to work, a lecture is given by one of the instructors in the simplest and most practical way. The things touched on are the meaning of the word combustion, excess smoke, how to remedy it, the importance of reducing the excess air to a minimum, the proper temperature at which to burn the oil, the analysis of the oil, the chemical symbols and their relation to each other.

Different types of flue gas analyzers are explained and how the chemicals are mixed to obtain the proper absorption of flue gas. At the beginning of the afternoon session, the class is assembled in the laboratory where the men are divided so that each man will have a partner and each team is given a flue gas analyzer and enough solution to make a complete charge so that each team fills its own machine

Babcock & Wilcox Boiler Equipped with Four Types of Oil Burners

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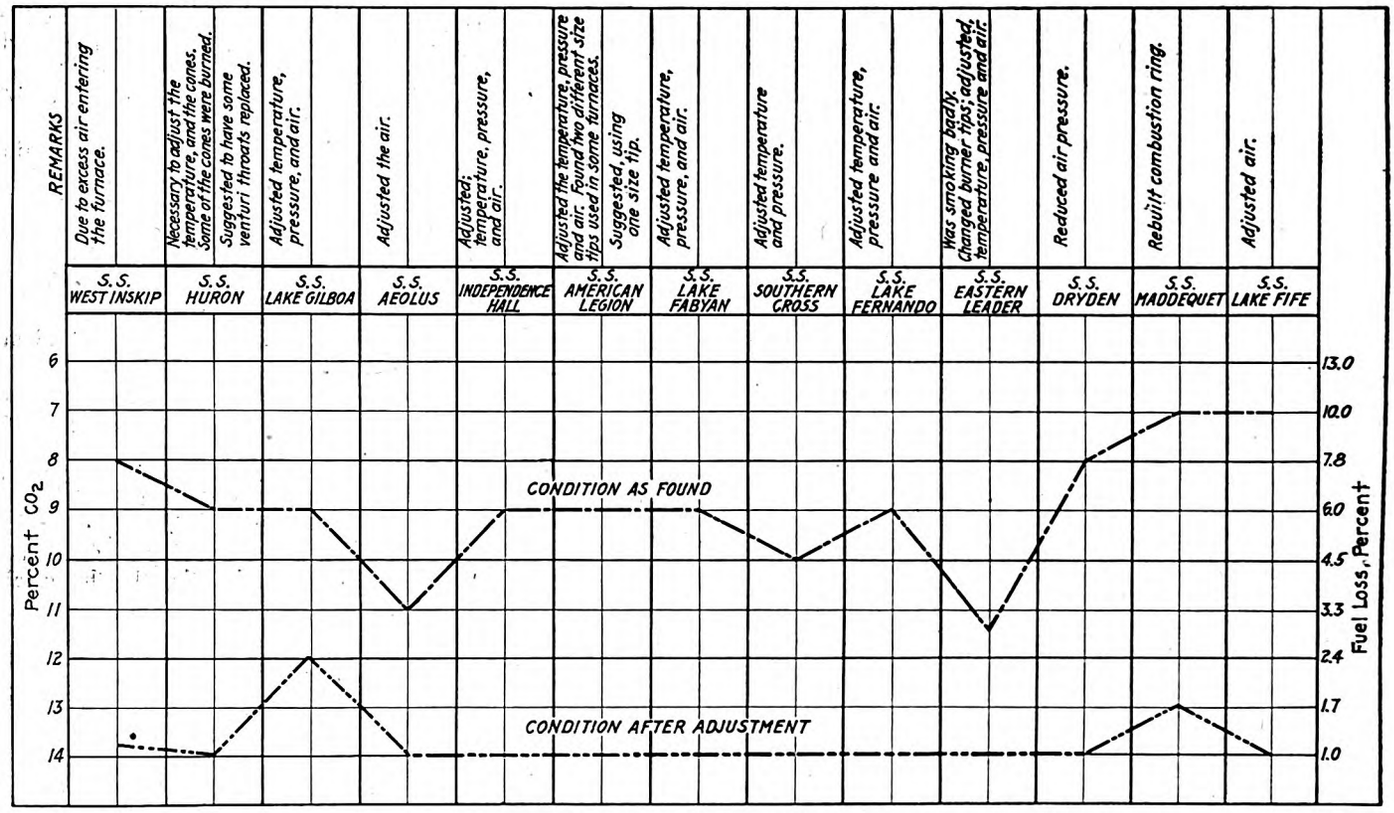


Combustion Report, Tests Made on United States Shipping Board Oil Burning Vessels

ready for a test of gas. When all machines are ready for use, the class is assembled in the test plant, each team has a connection on the boiler from the uptake from where the samples of the flue gas is to be taken for analysis.

The picture shows a Babcock and Wilcox boiler with four different types of oil burners used in the merchant service. The boiler under operation is taken care of by one of the instructors who does the adjusting to the oil burners in such a way as to give a low efficiency. It is the duty of every man to readjust the burner to the best of his ability. The boilers have peep holes on all sides and with colored glasses, a man can see just how the flame is performing in the furnace. After he is satisfied that he has the best possible adjustment, he takes an analysis of the gas. Great competition takes place in this part of the course to see who takes the honors for the highest CO_2 readings. It may be stated that the percentages of CO_2 readings run between 13 and 14 percent in most of the classes at the school.

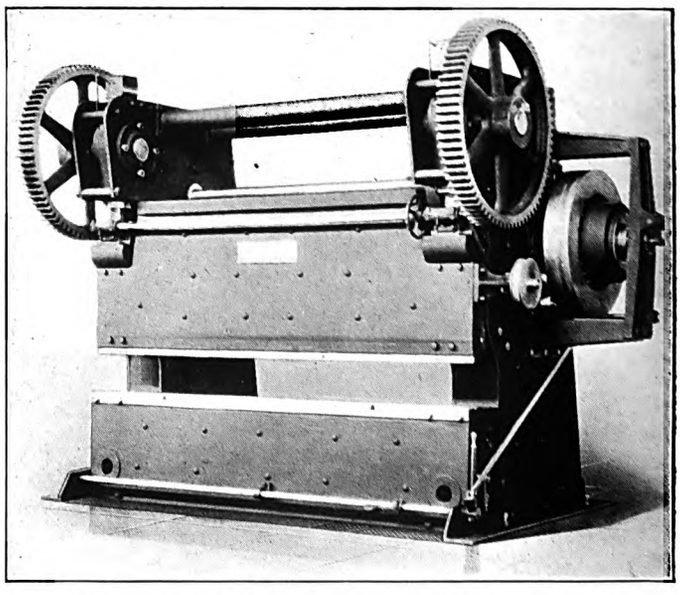
All-Steel Power Press Brake

A NEW development in the manufacture of heavy brakes has been made by the Cincinnati Shaper Company, Cincinnati, O., with the introduction of the Cincinnati all-steel press brake. This line of brakes has been designed with an open side in order to facilitate the handling of material. As most bends are made near the edge of the plate, the full length of the die-holding surface can be utilized. Thus, for most classes of work, a machine can be rated with respect to the length of the die-holding surface instead of the distance between housings, which means the use of a narrower, more rigid machine, and a saving in cost and floor space.

The bed and ram are constructed entirely of heavy steel plates and billets, which, together with cross ribs, are welded to each other, thus making what is virtually a heavy solid steel beam of box section with the metal placed to the best advantage. The housings are framed in steel plate, having cast steel members interlocked and welded to the plates. All the revolving parts run in a bath of oil.

To meet the demand for increased production these machines have been designed to operate at a greater number of strokes per minute than has been customary in brakes heretofore. The fly wheel is mounted on high duty ball bearings having hardened steel inner and outer races. The clutch is of the multiple disk type, especially designed and developed for this particular tool and operated in oil.

These brakes are built in capacities ranging from 80 to 600 tons for working material from 10 gage to ¾ inch in thickness. The widths between housings are 6 feet 6 inches to 14 feet 6 inches; the weights 18,000 pounds to 120,000 pounds.



Cincinnati Power Press Brake with Multiple Disc Clutch

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Regulations for Fire Prevention Aboard Ship

National Fire Protection Association Adopts Rules Governing Fire Hazards in the Construction and Maintenance of Vessels

THE following rules governing methods to be adopted in ship construction and maintenance for preventing the possibility of fire on board ship were prepared by the Committee on Marine Fire Hazards of the National Fire Protection Association and adopted at the recent annual convention of the association:

Throughout the following, where the word "approved" is used in designating type, construction, etc., it refers to the approval of the Inspection Department and Classification Societies having jurisdiction. No provision in these regulations is to be retroactive as regards construction.

Construction

Article I. Boilers

1. *Lagging.* All boilers, including steam domes, shall be thoroughly covered with asbestos or other approved heat-insulating material; such covering to extend down sides below the line of grate bars. However, vertical or donkey boilers need not be covered provided all woodwork within 18 inches at sides or within 2 feet 6 inches of uptakes or breeching is covered with sheet metal over sheet asbestos.

Note: Vessels having boiler houses with steel sides, ends, and roof, will not be required to have boilers covered.

2. *Floors.* All fire-room floors shall be covered with iron plate or at least 2 inches of cement, or other approved material. At least ¼-inch asbestos board or 1-inch plastic asbestos or equivalent shall be laid over all woodwork under a fire-room floor.

3. *Foundations.* The floor under the grate bars of all externally fired or leg boilers shall be of brick or cement at least 6 inches thick, vented by the insertion of old tubing laid horizontally, or its equivalent, under which shall be at least ⅛-inch asbestos board or 1½-inch plastic asbestos or equivalent covered with sheet metal. The floor under vertical boilers, if laid on a wood deck, shall be of brick or cement or other approved material, similarly vented, at least 2½ inches thick, extending out in front at least 3 feet; or, if less, shall have a fire-resistive coaming around said floor projecting at least 2½ inches above it, or be covered by a metal pan with projecting edges. On all such floors, under the brick or cement there shall be at least ¼-inch board or 1-inch plastic asbestos or equivalent covered with sheet metal.

4. *In Way.* Where coal and wood, or stores, or cargo of any description, except oil, are carried or may be carried alongside of boilers, a partition shall be built at least 4 inches clear, to prevent anything being placed next to the boilers; and under no circumstances may anything be placed between such partitions and the boilers. If anything is or may be carried near the back ends of boilers, similar partitions or bulkheads are to be fitted, but these shall be at least 2 feet distant from boilers, and space between them and boiler kept clear and clean. Under no circumstances may a wood platform, locker or grating be fitted over top of any boiler nearer than 12 inches, and no lines, clothes, or other combustible articles be laid over or alongside of boilers.

5. *Ash Guards.* A steel coaming at least 12 inches high shall extend from the front of all boilers to side partitions to prevent coal or ashes getting into wings.

6. *Drip Pans.* Where oil is used for fuel, on leg or externally fired boilers there shall be a drip-pan of heavy iron under the fire boxes to catch all drip. Where wood is used for fuel, a water pan shall be fitted under the grates, and a partition or metal screen erected to prevent cinders or sparks being blown into the woodpiles. In no case may the wood be stacked against the boiler.

7. *Casings.* The construction of the house or casing over and around the boiler should be of such nature that hot air or gases cannot be pocketed at any high point; but if such exist, suitable vent louvres shall be cut in sides of house or casings to provide a circulation of air.

8. *Bulkheads.* Screen bulkheads between fire room and engine room should, where possible, extend down to the tank top or shell of the vessel in order to form a fire wall between engine room and fire room bilges. Where oil burning equipment is installed, these bulkheads should be made oil-tight to at least two feet above the tank top and bilges to prevent any oil reaching the engine room bilges and tank top.

Article II. Stacks

9. *In Way.* Where a smoke stack passes through a wood deck, the woodwork should be cut away at least 12 inches from the stack and the wood faced with a metal collar over sheet asbestos; but where the construction of the vessel will not permit a space of 12 inches, there shall be an opening at least 4 inches wide around stack; this opening to be completely faced with a metal collar extending at least 6 inches above roof and 6 inches below same, and the carlins and roof on under side around opening, covered with sheet iron extending back radially at least two feet. Sheet asbestos at least ⅛ inch thick shall be placed under all metal.

10. *Umbrellas.* The bottom of the flange of the umbrella around stack shall be higher than the top of the flange around the opening in the deck, leaving a clear horizontal space for the escape of the gases or else a perforated coaming shall be used.

11. *Wood Burners.* The stacks of all vessels using wood for fuel shall be fitted with spark arresters.

Article III. Steam Pipes

12. *Lagging and Clearances.* All main and auxiliary steam pipe lines shall be thoroughly covered with asbestos or other approved material if within six inches of woodwork; and where such steam pipes pass through woodwork, they shall be fitted with a proper metal collar and the woodwork cut away or protected in an efficient manner.

Article IV. Bunkers and Holds for Coal

13. *Vents.* Ventilation of all hold, wing, and 'tween-deck bunkers shall be provided for by pipes or trunks leading to outside atmosphere.

14. *Temperature Testing.* Reserve bunkers and holds shall be provided with sounding trunks so that internal temperatures may be read as required.

Article V. Bunkers and Tanks for Oil

15. *General.* The storage of oil shall be restricted to cellular double bottom, hold, deep, peak, bunker, settling and other tanks specially constructed for this purpose. These compartments and tanks shall be fitted with approved bulkheads, sub-divisions or swash plates. They shall be so strengthened as to satisfactorily withstand the stresses brought upon them in a seaway when partially filled; and if separate from the hull, shall be properly braced and secured thereto by chocks or clips riveted to both tank and foundation. The scantlings and riveting shall be in accordance with the requirements of the American Bureau of Shipping, or approved equivalent, for vessels and tanks carrying oil in bulk.

16. *Location.* Fuel tanks should not be located on deck; but if such an arrangement is necessary, the installation must be approved.

In order to avoid as far as possible uncontrollable flooding in event of accident; the amount of piping under static head of fuel oil should be reduced to a minimum consistent with the design of the system.

17. *On Wooden Vessels.* On wooden vessels a lead lining shall be placed under tanks which are separate from the hull. Lining shall be not less than 8 pounds per square foot, laid over a coaming at least 6 inches high and drained to a sump fitted with independent stripping suction at the lowest point. These tanks shall be not less than 18 inches from boilers at all points except the back where they shall be at least 24 inches distant.

18. *Tests.* All oil storage compartments and tanks shall be tested by a head of water in accordance with the requirements of the American Bureau of Shipping or approved equivalent.

19. *Painting.* All oil tanks, compartments, and bunkers shall be thoroughly coated on the outside with a suitable non-flammable and rust-resisting material.

20. *Vents.* An independent, permanently open, iron vent pipe terminating in a goose neck or approved automatic valve in the open air and above the upper deck shall be provided for every oil tank, compartment or bunker.

Vent openings shall be screened (40 by 40 non-corrodible mesh) and of sufficient freeing area to permit unrestricted inflow of liquid during the filling operation (in no case less than two inches in diameter) and accessible for examination and removal.

Vents shall terminate well above the top of the fill pipe; or, if tight connection to the tank is made in the filling line, at a point one foot above the level of the top of the highest reservoir from which the tanks may be filled and never less than 3 feet, measured horizontally and vertically, from any porthole, window or other similar opening.

21. *Fill Pipes.* On tankers, fill pipe deck terminals shall be kept closed when not in use; and on other oil burning vessels, they shall be so designed as to make access difficult by unauthorized persons.

22. *Manholes and Hatches.* Manhole and hatch covers of oil tanks on all vessels shall be designed to fasten securely; and on oil burning cargo or passenger vessels shall be bolted, dogged or locked, and labeled or painted a distinctive color designating them as openings to oil tanks.

23. *Drainage.* Adequate means shall be provided by wells or gutter-ways and sparring or lining, to prevent any leakage from the fuel oil compartments coming into contact with cargo and to ensure that any such leakage shall have free drainage into the limbers or wells. In machinery spaces, such leakage shall be confined by gutter-ways to bilge cofferdam spaces next to tank bulkheads; and these spaces shall be drained independent of the main bilges by stripping suctions to a suitable pump.

24. *Double Bottoms.* If double bottoms under holds are used for carrying oil fuels, the ceiling shall be laid on transverse battens, having at least a two-inch air space between the ceiling and tank top and permitting free drainage from tank top into the limbers. The method of venting this space shall be subject to approval.

25. *In Way.* A clearance between oil tanks and boilers, boiler casings and breechings of not less than 24 inches at the back ends of boilers and 18 inches elsewhere shall be arranged; and all structures giving off heat shall be effectively insulated if within 18 inches of any oil tank or compartment.

26. *Cofferdams.* The practice of constructing a cofferdam between deep fuel tanks and cargo tanks or storage compartments is recommended for all oil burning steam vessels. Such construction is considered unnecessary on motor vessels using fuel other than gasolene. On steam vessels burning oil of a flash point lower than 150 degrees F., closed cup, there shall also be a cofferdam between fuel bunker and fire-room compartment. The space enclosed by cofferdams shall be vented in accordance with the provisions of section 20.

Article VI. Oil Burning and Heating Systems

27. *General.* It is strongly recommended that systems whereby oil is pumped from tank to the burners be used; but in cases where pumping system is deemed impracticable and the use of gravity feed is desired, special permission shall be obtained for installation and detailed plans submitted and approved.

Pumps shall be in duplicate, of an approved design, well secured against leaks under a test pressure 50 per cent in excess of the designed pressure of the system carried.

Whether pumps are located inside or outside of the fire-room, gear shall be installed for operation from deck of stop valves on each tank and throttle valves on both service and booster pumps. This provision does not apply to fuel pumps on motor vessels.

On steam vessels burning oil of a flash point lower than 150 degrees F., closed cup, the pumps handling such oil shall be located in a compartment separated from the rest of the machinery space by gas-tight bulkheads and accessible therefrom only by a gas-tight door.

The piping and spindles of fire-room controls shall be made gas-tight where they pass through the pump room bulkheads.

This pump room shall be provided with induced ventilation always sufficient to reduce the pressure therein slightly below that in the compartment from which entry is made. The provision of section 20 shall also be observed.

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28. *Oil Level Indicating Devices.* Devices for ascertaining or indicating the oil level in storage and service tanks shall be provided. Use of gage glasses is prohibited except on motor vessels using fuel other than gasolene. Sounding pipes and spring loaded trycocks normally closed are approved. It is recommended that, where practical, a compression chamber connected by air piping to a mercury gage be installed, with gage and annunciator mounted on a board to indicate and signal audibly when the contents of each tank reaches a predetermined level. Other methods of meeting this provision are subject to approval.

29. *Heating of Tanks.* Where it is necessary to heat oil in storage tanks in order to handle it, the heating shall be done by means of properly installed coils or other approved system using only steam or water. Thermostatic control and thermometer are recommended for all heating devices.

30. *Heaters, Other Than Those for Tanks.* Heaters shall be of substantial construction with oil-tight joint. Only steam, water or approved electric device may be used for heating. A ½-inch relief valve, set at 400 pounds per square inch and discharging to the suction line or tank shall be fitted on the oil side of all heaters to prevent the accumulation of excess pressure when the heater is shut down, due to expansion of the oil caused by leaky steam supply valve or failure to shut off the steam supply.

31. *Burners and Air Registers.* Drip pans shall be fitted under each burner. Air registers should include provisions for the inspection of burner tips while register is in use. Registers should permit ready adjustment in area of air openings.

Burners shall be fitted in the registers so that they may be shut off, readily removed, or cleaned independently of each other.

Article VII. Fuel Oil Piping and Fittings

32. *Tank Piping.* A piping system for fuel oil storage tanks separate and distinct from other piping in the vessel is recommended; but an interchangeable system providing a method which precludes the possibility of a mixture of ballast water and oil may be used subject to approval.

33. *Type and Material.* All piping and fittings comprising the fuel oil system between pumps and burners shall be of the extra heavy type. Seamless drawn pipe is recommended for all pressure lines, but in installations burning oil of a flash point lower than 150 degrees F., closed cup, such piping shall be seamless drawn. No pipe less than ⅜ inch internal diameter may be used. Unions, if used in place of right and left couplings, shall be of an approved type.

34. *Installations.* All piping shall be run as directly as possible without sags and so installed that, where possible, pipes pitch toward supply tanks without traps, and provisions shall be made for expansion, contraction, jarring and vibration.

35. *Test.* Oil piping between pumps and burners shall be tested and proven tight at a pressure of not less than 500 pounds per square inch. All joints and fittings in the pressure piping shall be kept oil-tight under service conditions.

36. *Protection.* Piping shall be exposed to sight wherever possible to insure prompt detection of leaks, and shall be protected against mechanical injury in an approved manner.

Pipes extending above the floor, particularly risers to furnaces, shall be effectively cased or jacketed to prevent loosening or breakage.

Fill and vent pipes shall be protected in an approved manner against mechanical injury.

37. *Valves.* All valves shall be of an approved type. Shut-off valves shall be located as follows: On both sides of any strainers installed in pipe lines; in discharge and suction lines at the pumps; in discharge and suction lines to any tank, directly on the tank; and in branch lines to burners.

A pressure relief valve shall be installed in the discharge line to burners and so arranged as to return surplus oil to the suction line.

38. *Strainers.* Duplex strainers shall be fitted in the suctions of both booster and fuel oil service pumps; provided, however, that if booster pumps are used to deliver oil to the suctions of the service pumps, the strainers need be fitted only in the booster suction. Strainers shall be so designed that one side can be cut out for cleaning while the other is the service.

Article VIII. Lighting

39. *Lamp Rooms.* All wooden oil and lamp rooms or lockers shall be completely lined with sheet metal nailed over asbestos at least ¼ inch thick, and nailing protected in accordance with National Fire Protection Association standard for fire door construction. No openings except doors or covers will be permitted.

40. *Oil Lights.* All oil lamps shall have metal bodies and, except hand lanterns, shall be kept in brackets well secured or suspended and stayed. They shall be secured in the brackets by an approved device for holding them in place, and shall have metal shields over them. Hand lanterns when suspended shall be secured by clips. It is recommended that solidified fuel, being safer and smokeless, be used in lamps, where possible.

41. *Electric Lights.* On all vessels using electric lights, the wiring for same shall be run in armored cable or metal conduit in the following locations: In holds, in engine and boiler rooms, in bunkers, in cargo spaces or other places where cargo is carried, and where wiring is run outside. Switchboards, fixtures, wiring and all other electric apparatus shall be installed in accordance with the rules of the National Electric Code.

Note: The "Recommended Practice for Electrical Installations on Shipboard," issued by the American Institute of Electrical Engineers is recommended as a guide for electrical installations. This is consistent with the requirements of the National Electrical Code and goes more into detail both with regard to good practice as affecting fire hazards, and also with regard to many other questions of installation, maintenance and operation having bearing on durability and safety on vessels.

Article IX. Galley and Heating

42. *Ranges.* The galley range shall be securely fastened to the deck, at least 1 inch air space or approved equivalent insulation being provided between the bottom of range and deck; and, if galley floor is wood, range shall have metal under it extending out in front at least two feet. If range is within 18 inches of a wooden bulkhead, such bulkhead shall be covered with sheet metal over asbestos at least ¼ inch thick. All smoke-pipes or stacks passing through wooden bulkheads or partitions shall be fitted with a proper metal collar and have woodwork cut away. Galley ranges shall have metal hood over them or have the ceiling protected with sheet metal over asbestos at least ⅛ inch thick. No wooden warming racks over stoves will be permitted.

43. *Steam Heat.* A complete steam-heating plant on steam vessels is recommended. All steam-heating pipes and radiators shall be kept clear of woodwork. Where radiators are adjacent thereto, a metal shield shall be fitted behind each with ¼ inch air space between shield and woodwork.

44. *Stoves.* The use of stoves is discouraged; but where used, they shall be securely fastened to the deck, at least 1 inch air space being provided between bottom of stove and deck; and shall have sheet metal on the floor under them extending out on all sides at least 12 inches. If stove is within 18 inches of a wooden bulkhead, such bulkhead shall be protected with sheet metal over asbestos at least ¼ inch thick. All smokepipes or stacks passing through wooden bulkheads or partitions shall be fitted with proper metal collars and have woodwork cut away; and all woodwork within 8 inches of smokepipe shall be protected with sheet metal over asbestos at least ¼ inch thick.

Appliances

Article I. General

45. In addition to fire fighting equipment required by rules of United States Steamboat-Inspection Service, it is recommended that small gear such as smoke helmets, life lines, slickers, and gloves, be provided and kept in approved convenient places.

Article II. Hose and Couplings

46. Hose shall be of an approved type. All hose couplings and fittings shall be in accordance with national standard of the National Fire Protection Association.

Article III. Sprinklers

47. *Features of Design.* To improve and encourage the use of sprinkler fire protection aboard ship, it is recommended that the following features be incorporated in any system.

The system and apparatus should be as simple and inexpensive as possible; and, so far as applicable to marine work, should comply in detail with regulations of the National Fire Protection Association.

The design should be such that it would operate only in case of fire, and not subject the ship or its contents to consequential damage due either to freezing, accidental operation, breakage or to any causes other than fire. To this end, the sprinkler pipes should preferably be empty and under atmospheric pressure; but served by fire pumps of ample capacity. The control should be dual, both manual and automatic; but it is recommended that the automatic feature be attained only through the use of a thermostatic control or other system which would prevent release of water except in the presence of heat.

48. *Location.* Automatic sprinkler equipment is recommended in cabin, store, crew and passenger spaces; and optionally, in cargo and machinery spaces, owing to the usual impracticability of stowing cargo or arranging machinery to all proper distribution of a sprinkler equipment.

Article IV. Smothering Devices

49. *Steam Jets.* Steam jets controlled by master valves in accessible location are considered a satisfactory means of fighting fires in the cargo spaces of a vessel in the present stage of development of extinguishing apparatus. The size and number of steam smothering pipes called for herein are based on a steam pressure of 100 pounds. These sizes are suitable for higher pressure than 100 pounds, but for lower pressure they should be proportionately increased.

(a) Each compartment shall have a branch with steam jets of sufficient size to fill it in not more than fifteen (15) minutes.

(b) The main supply pipe from boilers on steam line shall be of sufficient size to supply 50 percent of the total volume of all the cargo spaces at one time.

(c) Main supply line on deck, running forward and aft, shall be of equal area at any point to the combined area of the branches taken from same, but at no point need its area be in excess of the main supply from machinery space of 50 percent of the area of all the branches in the vessel.

(d) The orifice area of the steam jets supplied by any branch pipe shall be at least equal to the cross sectional area of such pipe; that is, the end of the pipe may be left open, or it may be closed and a number of openings made in the pipe, the combined area of which shall be at least equal in area to the open end of the pipe.

(e) Maximum size of branch steam pipe to any cargo compartment shall be one and one-half inches (1½ inches) nominal diameter.

(f) Cargo spaces requiring more steam than would be supplied by a one and one-half inch (1½ inch) pipe shall have additional branch pipes and steam jets.

(g) Minimum size of branch pipe to any cargo compartment shall be one inch (1 inch) nominal diameter.

(h) Minimum size of branch pipe to lamp rooms, paint lockers, etc., shall be three-quarters inch (¾ inch) nominal diameter.

Where

L—Length of compartment, in feet.
B—Breadth of compartment, mean, in feet.
H—Depth of compartment, mean, in feet.
D—Diameter of pipe required, in inches.

Then

$$D^2 = \frac{L \times B \times H}{30{,}000}$$

Or in accordance with the following table:

Values of $L \times B \times H$	Connection No. of Inlets	Size of Inlets Inside Diameter, Inches
30,000	1	1
46,000	1	1¼
67,000	1	1½
94,000	2	1¼
135,000	2	1½
203,000	3	1¼

Size of main steam pipe

$$D^2 = \frac{\text{Summation of all } (L \times B \times H)}{60{,}000}$$

50. *Gas.* The use of inert gas, such as carbon dioxide for extinguishing or preventing fire may be applied to holds, bunkers, and other closed compartments not normally accessible to crew or passengers; but, on account of danger to life, the use of gas of this character shall be restricted to such spaces. On motor vessels and those equipped with insufficient boiler capacity to permit effective application of steam smothering, the installation of a gas system, subject to the foregoing restrictions, is recommended.

Article V. Fire Room Apparatus

51. *On Coal or Wood Burners.* In addition to regularly prescribed hose and extinguishers in each fire room; steam fire hose, coupled to the injectors and of sufficient length to reach all parts of fire room, should be provided.

52. *On Oil Burners.* In fire rooms with oil burning boilers a sufficient number of 2½-gallon foam-type chemical fire extinguishers shall be provided; and a box of dry sand with a scoop may also be supplied. It is also recommended that an extinguishing system be piped to inaccessible parts of fire room, such as under boilers and floor plates and in bilges. A foam or steam-smothering installation is approved for this purpose. Either an automatic or manual system or a combination of both may be used, but control of all manual systems should be from both inside and outside of the fire and engine room spaces. The type, number and location of extinguishers and layout of pipe lines and nozzles shall be subject to approval.

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ARTICLE VI. EXTINGUISHERS

53. *General.* Hand chemical extinguishers should be distributed through all parts of the vessel accessible to crew or passengers, and the selection and distribution governed by the regulations of the National Fire Protection Association Committee on Field Practice. All extinguishers should be of types approved by the United States Steamboat-Inspection Service, and on the list of inspected mechanical appliances issued by the Underwriters' Laboratories.

ARTICLE VII. DETECTION AND ALARM

54. *General.* It is recommended that on passenger and cargo vessels, except tankers, pipes for detection of smoke or fumes be led from holds, bunkers and inaccessible parts liable to fires, to the bridge, engine room or other points where they may be readily observed; and that vessel be equipped throughout with a fire alarm system approved as to type and installation.

Operation

ARTICLE I. GENERAL REQUIREMENTS

55. In addition to the United States Government rules as to operation, quarters, stowage and packing of hazardous cargoes, etc., the following are recommended or required as noted:

ARTICLE II. DRILLS AND QUARTERS

56. It is recommended that certain members of the crew be designated as fire wardens and trained to special duties, such as use of smoke helmets and extinguishing apparatus, life saving, etc.; and that some form of compensation or privilege be accorded the men so designated.

ARTICLE III. CARE OF COAL BUNKERS

57. Care shall be taken that all vents are clear when bunkering is completed. In case of vessels having wooden bunkers using soft coal for fuel, same shall be thoroughly cleaned out at least once every sixty days while vessel is in commission. The coal bunkers of all vessels shall be cleaned on going out of commission or being laid up for over sixty days, making sure that all coal dust and rubbish are removed. Special care shall be taken in cleaning shelf pieces.

ARTICLE IV. PAINTING

58. Care shall be taken to ventilate, so far as possible, all confined spaces where paint containing inflammable ingredients is being used or stored, and naked lights in such spaces are prohibited. Paint lockers shall not be located in close proximity to boilers or stacks.

ARTICLE V. FUEL OIL REQUIREMENTS

59. *Flash Point.* These regulations are intended to apply generally to those oil burning equipments using only liquids having a flash point above 150 degrees F., closed cup tester; however, the necessity, under certain conditions, of burning fuel oil of lower flash than this point is recognized and additional requirements for the use of such oils are noted in sections 26, 27, 33 and 78 of these regulations. No untopped oil shall be used for fuel except in accordance with these additional precautions.

60. *Flash Test.* In determining the flash point, either Elliott, Abel, Abel-Pensky or Tag closed testers shall be used, but the Tag closed testers (standardized by the United States Bureau of Standards) shall be authoritative in case of dispute. All tests shall be made in accordance with the methods of tests as adopted by the American Society for Testing Materials.

ARTICLE VI. LOADING AND BUNKERING OF OIL

61. *Preliminary.* Before commencing to load oil, all signal bells, gongs, etc., shall be tested to insure working condition.

62. *Oil Hose.* Hose used for filling or discharging shall be of the flexible metallic type equipped with oil tight flanged joints or some other approved coupling device for the purpose of preventing rupture of connections. The inner metallic lining of such hose shall be effectively grounded against possible charge of induced electricity.

63. *Hatches and Manholes.* No double bottom, deep, peak or independent tank manhole or hatch opening shall be used for fuel oil filling purposes, except on tankers where trunk hatches extend to weather deck and proper warnings are posted while operation is underway.

Hatches on tankers shall be kept closed during loading or discharging except when in use for such purposes. Tugs or other steam vessels shall not be allowed alongside when oil tank hatches are open.

64. *In Way.* While oil is being received or discharged, no open lights or fire, smoking, or electrical apparatus liable to spark shall be permitted within 50 feet of an opening in any oil hose, tank or compartment containing a tank or vents.

65. *Galley.* If practicable, galley fires in tankers shall be extinguished during loading or discharging; otherwise, openings to the galley shall remain tightly closed.

66. *Lights.* Loading or discharging should, as far as possible, be carried on in the day time. When carried on at night, no lights shall be permitted on the deck. Flood lighting or lights in clusters suspended in the rigging well above the deck are approved. Wires shall not lie on or drag across the deck. The use of portable connected electric lights on deck of tankers or in tanks or pump rooms of any oil burning or oil carrying vessels is prohibited.

ARTICLE VII. TANK CLEANING AND DISPOSAL

67. *Dry Dock.* When vessels containing fuel oil of any kind are in dry dock, care shall be taken that no oil drains onto the dock. Should it be necessary to remove oil from tanks, precautions shall be taken to prevent any oil escaping to form an accumulation of vapor or oil on or around the dock. Should any oil so escape, it shall be skimmed and disposed of ashore.

68. *In Port.* Tankers or other vessels carrying water for ballast in fuel oil compartments or double bottom, shall not discharge such water ballast into rivers or harbors or adjacent to ships or docks.

69. *Tank Freeing.* Tanks, valves and pipe lines throughout the vessel shall be freed of vapor in accordance with the regulations of Appendix A before repairs in way are undertaken.

ARTICLE VIII. PRECAUTIONS ON OIL BURNING AND TANK VESSELS

70. *Inspection.* The inside of oil compartments and tanks should be inspected at least annually; and bulkheads separating such compartments from others should be examined for leaks during inspections and whenever oil is taken aboard.

71. *Tank Readings.* Gage valves or cocks fitted to the storage or settling tanks shall be kept closed, except when a reading is to be made; and shall be closed immediately upon completion of the reading.

72. *Dampers.* Dampers in stacks and up-takes shall always be kept sufficiently open while burning oil, in order to prevent dangerous accumulations of vapor in the furnace or breechings with consequent blowing back into the fire room.

73. *Tests.* Whenever that part of the oil system subject to pressure has not been in use for a week, or after joints in the same have been remade, it should be tested cold under a pressure at least equal to the working pressure; and a careful inspection made for leaks before fires are lighted. All fuel oil fittings should at all times be kept in working order; and the oil slats, drafts, and valves should be frequently moved when not in use to insure such condition.

74. *Vents.* Frequent inspection shall be made to insure that wire gauze screens in vents are clean and intact.

ARTICLE IX. FURNACES AND FIRES ON OIL BURNING AND TANK VESSELS

75. *Re-Lighting.* In the event of oil accumulating in the furnace, such as might be caused by sudden extinguishing of the burners, the vapor must be blown out and drip oil removed before burners are again lighted.

76. *Fire Room.* Oil shall not be permitted to accumulate in the oil boxes, openings of furnaces, bilges, or on the floor plates; and no lighted material shall be allowed access to the bilges. After fires are out, bottoms of furnaces shall be examined and any oil remaining removed. In case of leakage of oil system in fire room, immediate action shall be taken to shut off the oil supply.

77. *Galley.* On tankers, when coal burning galley fires are lighted, the use of waste, chips, oil, etc., shall be prohibited, and only a limited amount of wood covered with coal shall be used. Every precaution shall be taken to prevent sparks or flame from blowing out the smokepipe.

78. *Low Flash Oil.* When oil of a flash point lower than 150 degrees F., closed cup, is used, attention is called to the extra hazard incurred by permitting any such oil to escape and gas therefrom to form an explosive mixture with the inclosed atmosphere of fire room or compartment. Rules for handling, heating and burning of such oil should be laid down by the superintending engineer according to his best judgment and experience, and no deviation therefrom on the part of engineering subordinates allowed. This general regulation is promulgated pending the results of further investigation of low flash oil hazards.

79. *Matches.* The use aboard tankers or oil burning ships of other than strike-on-box matches is prohibited.

ARTICLE X. CARGOES

80. *General.* A comprehensive treatment of the subject of hazardous cargoes and their packing and stowage is beyond the scope of these regulations; but specific cases for stowage of such cargoes may be referred to regulations of the following authorities: Interstate Commerce Commission for transportation on railways of United States as contained in Bureau of Explosives Pamphlet No. 9; United States Steamboat Inspection Service, as contained in Revised Statutes No. 4472, and special bulletins; and the Rules of the American Steamship Owners' Protection and Indemnity Association; which regulations the committee recommends adopting in full, pending regulations to be drawn by the Interstate Commerce Commission covering marine transportation as authorized by Act of Congress in March, 1921.

Appendix—A

Regulations for Freeing Oil Tanks, Bunkers and Compartments of Flammable and Explosive Vapors Previous to Entering for any Purpose or Making Repairs on Oil Burning or Oil Tank Vessel.

1. For the purpose of these regulations, an "explosive or inflammable liquid" is defined as one which when vaporized and mixed with air in proper proportions, is flammable or explosive.

2. No repairs of any kind shall be made to any tank, compartment, bunker, or other container or space, previously containing explosives and flammable liquids, in any vessel until the requirements hereinafter outlined have been complied with.

At sea or in ports where the means of carrying out these requirements are not available and the safety of the vessel necessitates emergency or temporary repairs, such repairs may be made to permit the vessel to proceed to the port of destination.

3. The process of freeing such containers of vapor shall be as follows:

4. (a) Tanks shall be closed and live steam blown into the tanks or space to be cleaned and all pipes leading thereto or therefrom for a period of time to be governed by the condition and the nature of the oil carried. Vent pipes shall be proved and left open.

Inasmuch as the time for steaming will be determined by the foregoing, no definite rule is laid down to cover all contingencies, but the following table is recommended as covering average general conditions:

Where:
L—Length of compartment in feet.
B—Breadth of compartment in feet.
H—Depth of compartment in feet.

The time of steaming is arrived at by taking the number of hours given in the table under the actual size of steam connection corresponding to the value given for $L \times B \times H$, or the volume in cubic feet of the compartment to be steamed.

Value of $L \times B \times H$ Not Exceeding	Size of Steam Connection at 100 pounds pressure		
	1 Inch Hours Steaming	1¼ Inch Hours Steaming	1½ Inch Hours Steaming
30,000	20	14	10
40,000	26	18	13
50,000	32	22	16
60,000	38	26	19
70,000	44	30	22

The above calculations are based on a steam pressure of 100 pounds per square inch.

Note: In steaming tanks the last one-fifth of the steaming period should be carried out with manhole plates or tank lids opened to the atmosphere.

(b) Upon completion of the operation above noted the tank or space so treated shall have all manhole plates and covers or other openings removed and thoroughly ventilated by means of wind sails, forced or induced draft.

(c) Following this process, specimens of air shall be taken by a competent chemist, whose ability and reliability shall be certified to by the American Bureau of Shipping. These samples shall be analyzed or tested by him, and if the tank or space from which samples have been taken still contains explosive or flammable gases, such further steaming, and/or ventilating shall be carried out as recommended by the chemist. After such steaming and/or ventilating, further samples shall be taken by him and analyzed or tested; this process to continue until the tank is certified by the chemist to be free of all explosive or flammable gases.

5. (a) In cases where a tank or space to be repaired adjoins another tank or space, no repairs shall be permitted unless adjacent tanks or spaces are freed of vapor as provided in paragraph 4 (c).

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In cases where a vessel having carried cargo of flash point below 150 degrees F., closed cup, is to undergo repairs at a shipyard, or alongside a wharf, all the vessel's compartments or tanks containing inflammable gases, with the exception of the ship's bunker tanks, shall have been steamed and ventilated for at least twenty-four hours prior to delivery to repair yard, and all tanks in which any repairs are to be made, and tanks adjacent to same, shall have been freed from explosive or flammable gases as provided in paragraph 4 (c); the balance of the tanks shall be sealed tight.

The only exception to this rule shall be, where the repairs to be made are confined exclusively to the engine and fire room spaces or/and to quarters, or where vessel is placed on dry dock merely for the purpose of cleaning and painting under water body and overhauling sea valves, in which case it will only be deemed necessary that all tank lids and/or covers shall be sealed tight.

(b) Repairs may be made to equipment, etc., in pump room without freeing from gas any space on the vessel other than pump room space.

(c) No repairs necessitating the use of fire or of tools liable to cause sparks by contact with metal, may be made to the decks of a vessel, except by special permission of the certified chemist, without first freeing adjacent tanks from explosive or flammable gases.

6. (a) The tests herein prescribed and required shall be made as provided by a competent chemist whose ability and reliability shall be certified to by the Americna Bureau of Shipping.

(b) Where oil or sediment liable to regenerate explosive or flammable gases has not been entirely removed from the tank in which repairs are to be made, the above mentioned certified chemist shall, when delivering to the interested parties the gas free certificate, required by these regulations, advise them as to the necessity, if any, of further testing of said tanks while undergoing repairs, and such tests shall be made before proceeding with repairs in the tanks.

7. While repairs or cleaning operations (but not air sampling) are under way, a current of air under forced or induced draft shall be continuously circulated through the tank or other space.

Note: Ventilation may be accomplished by wind sails, draft forced or indirect by a blower, pump or fan. It is recommended that compressor or other air unit have a minimum capacity of not less than 400 cubic feet of free air per minute.

8. (a) No open lights or fires shall be permitted within 50 feet of an opening in any tank or space not conditioned for repair as previously outlined. Lights carried into such tanks shall be electric of a type approved by the Bureau of Mines for use in gaseous mines. Electric hand flash lights may be used as accessories.

Note: If possible, all repairs should be made during daylight. Portable connected electric lamps are prohibited. Self-contained electric battery lamps may be used.

(b) No repairs of any kind shall be made until the foreman is provided with a permit signed by the superintendent. This permit shall not be issued until tank or other container has been freed of vapors as previously outlined, and shall be carried by the foreman in charge, and shown upon request to anyone in authority.

Note: It is recommended that a permit form similar to the following be used for this purpose:

Date.....

Fire Permit No.....

Permission is hereby granted to.....

(Foreman) to make repairs, including any repairs necessitating the use of fire on.....

as follows.....

.....

.....

Subject to the following conditions:

Fire to be kept as low as possible. All precautions to be taken to prevent sparks from flying. When finished using for the day, fire must be extinguished and coals thoroughly wet.

Approved

.....Supt.....

.....

9. Should any emergency require the entering of a tank, bunker or other space before it is thoroughly free of vapors, the person or persons so entering shall be protected by a gas mask approved for such purpose by the Underwriters' Laboratories in accordance with tests prescribed by the United States Bureau of Mines. A rope shall be attached to the body of each man at work in the tank and each rope held by two strong men outside the tank. Persons at work within the tanks shall be under constant attendance, so that upon any indication of trouble they may be withdrawn.

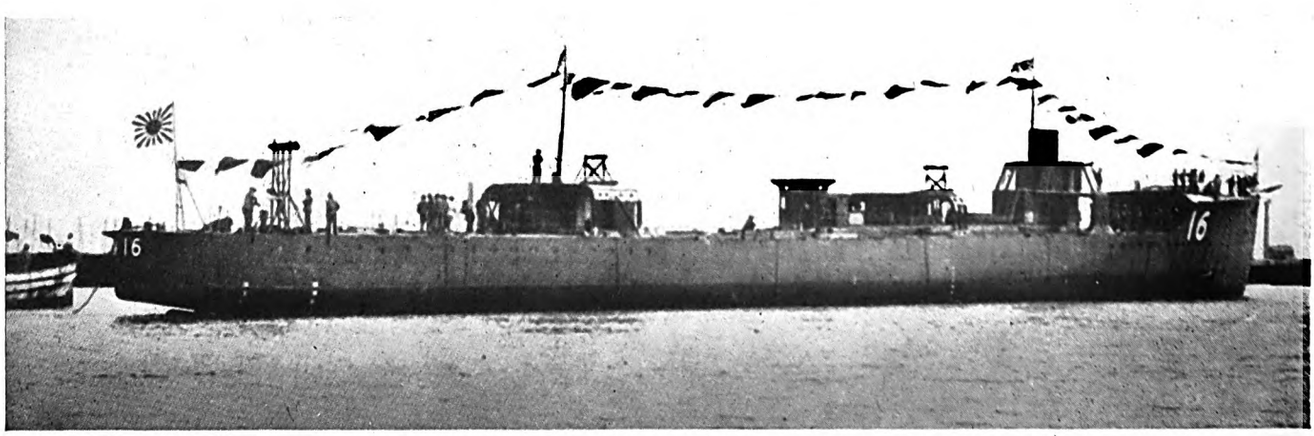
Oxygen breathing apparatus may be worn for a period of not more than 20 minutes, after which it shall be aired in fresh air for not less than 6 hours before further use. Wearers of respiratory apparatus shall be instructed and trained in their use before being permitted to enter a dangerous atmosphere.

The Isherwood System of Ship Construction Shows Remarkable Growth

THE progress returns for the "Isherwood" System up to the end of 1920 showed some remarkable figures regarding the number of orders placed, but a great falling off in the shipbuilding industry has taken place since that time which is reflected in the number of contracts made for vessels to be built on the "Isherwood" plan during the past two years. The following table, however, is of considerable interest because, in addition to recording the number and deadweight tonnage of "Isherwood" ships contracted for in each year from 1907 to 1922, it shows to some extent the general activities of the shipbuilding industry during that period of which the "Isherwood" System has taken no small part.

Year	Number of ships built under construction and on order	Deadweight Carrying Capacity
Sept., 1907, to Dec., 1908....	6	31,609
1909	30	181,384
1910	40	271,760
1911	64	474,043
1912	100	818,553
1913	30	215,686
1914	41	358,288
1915	157	1,196,899
1916	152	1,117,779
1917	180	1,666,150
1918	250	2,375,550
1919	210	1,887,000
1920	135	1,367,700
1921	23	70,000
1922	13	69,490
Total.....	1,431	12,101,891

FROM HAMBURG TO PERSIA BY WATER.—During the latter part of July, 1922, the Hamburg Shipping Company, August Bolten, dispatched a specially constructed steamer of 200 gross tons from Hamburg for Enseli, Persia, in order to ascertain the practicability of establishing a regular freight service between Germany and the Near East via the Russian waterways. The vessel sailed through Russian rivers, canals and lakes into the Caspian Sea loaded with a cargo of miscellaneous merchandise and is to remain at Enseli until ice conditions on the Russian waterways permit it to return to Hamburg with a cargo of native merchandise. In view of the apparent success of this expedition the shipping company is planning to extend its services and has placed orders for several ships of a type suited to this route.



(Photograph by Kadel & Herbert, N. Y.)

Japanese Battle Destroyer No. 16 Launched at Fusinagata Shipyard, Osaka, Japan

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Stresses on Vessels of the Great Lakes Due to Waves*

By Professor Herbert C. Sadler† and Professor A. Lindblad††

When the Committee on Bulkheads and Freeboard met to consider the various problems upon which it was to report, the question of the possibility of including vessels on the Great Lakes in the assignment of freeboard arose. As little or no systematic investigation into the strength of this type of vessel had been made, it became necessary to make several strength calculations for the conditions met with in this region. As information of this character may prove of value in other fields, it was thought advisable to have the same in the permanent records of our society. The results of the principal parts of these investigations are submitted herewith.

IN considering the assignment of freeboard to vessels on the Great Lakes, it became necessary to find out what lengths and heights of waves might be expected. Little or no data upon this subject existed, so a series of instructions was issued to captains of vessels in order that they might observe and report upon the waves encountered. Although all possible care was taken on the part of the observers, there was still a chance of error. On the whole, however, the data obtained were sufficiently reliable for the purpose in hand.

A few of the general conclusions are as follows:

1. As a rule, waves over 250 feet in length are rarely encountered. In one case, a report was made of waves in the neighborhood of 350 to 400 feet after a severe storm on Lake Superior, but although the height was not observed it was evidently not of the usual magnitude, judging from other comments on the behavior of the ship.

2. The heights of the waves appear to be somewhat larger in proportion to their lengths than the usual ratio of 1:20, and probably vary between this figure and 1:15. The actual heights did not appear to exceed 20 feet as a maximum.

The following waves were therefore used in the calculations: (*a*) 325 feet by 20 feet; (*b*) 300 feet by 20 feet; (*c*) 250 feet by 16.7 feet and two special cases 325 feet by 15 feet and 350 feet by 20 feet, in order to obtain some intermediate data. As these waves are considerably shorter than the usual run of vessels on the Lakes today, it was necessary to perform two sets of calculations, one with the crest and one with the hollow at the bow.

Three types of vessels were chosen of the following dimensions: (*a*) 420 feet by 52 feet by 28 feet; (*b*) 504 feet by 56 feet by 30 feet; (*c*) 590 feet by 64 feet by 33 feet.

The wave profiles and corresponding positions of maximum bending moment are shown in Fig. 1 for all of the above cases, and the detailed shearing force and bending moment curves in the following Figs. 2 to 4.

As these vessels tend to sag when uniformly loaded, it is customary to put some additional cargo in the forward and after ends. This method of loading has been assumed as the proper one, although calculations were also made for uniform loading.

It will be noticed that both the magnitude and position of the maximum bending moment depend upon whether the crest or hollow is assumed at the bow, and also that it depends upon the wave dimensions. If the effect of varying heights of waves of the same length is desired, it was found that, for moderate changes, the bending moment varies as the square root of the height.

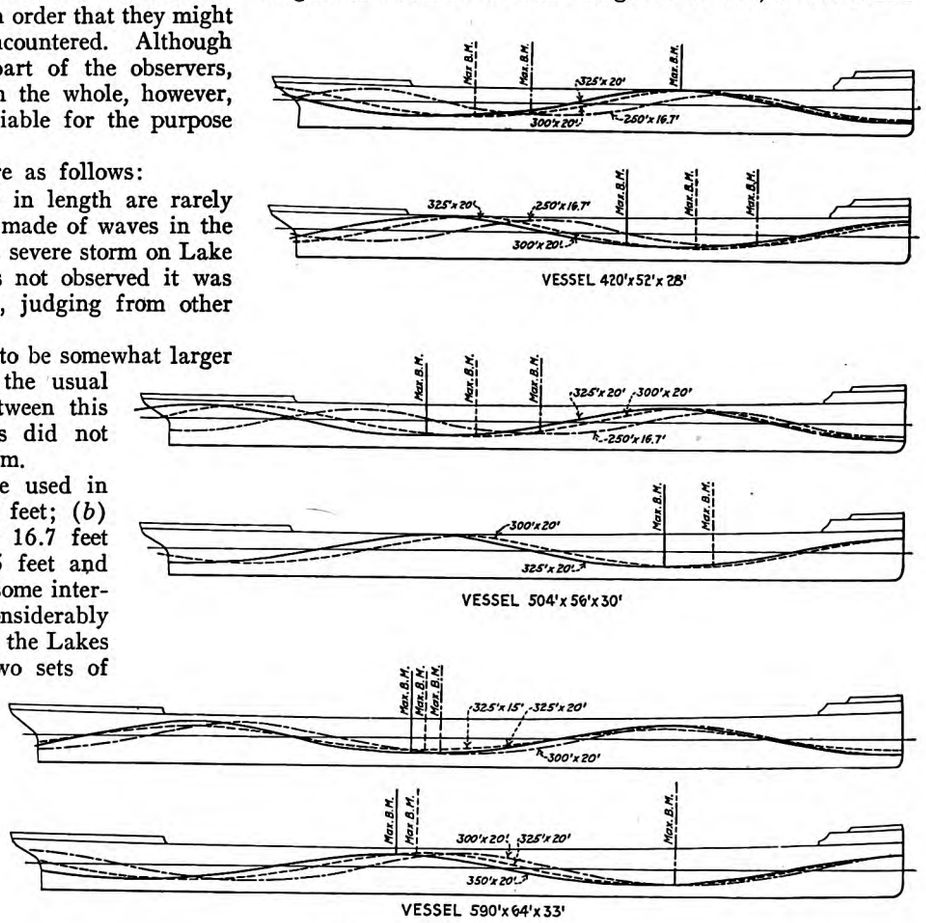

Fig. 1.—Wave Profiles

The results have been summarized in Figs. 5 and 6 in the form of bending moment factors.

These charts are reproduced on page 107.

Stresses

While the foregoing may be considered as general data with regard to bending moments on vessels, it may be of interest to add the special application in the determination of the strength of lake vessels.

If we take the form proposed by the British Committee

*Paper read at annual meeting of Society of Naval Architects and Marine Engineers, New York, November 8, 1922.

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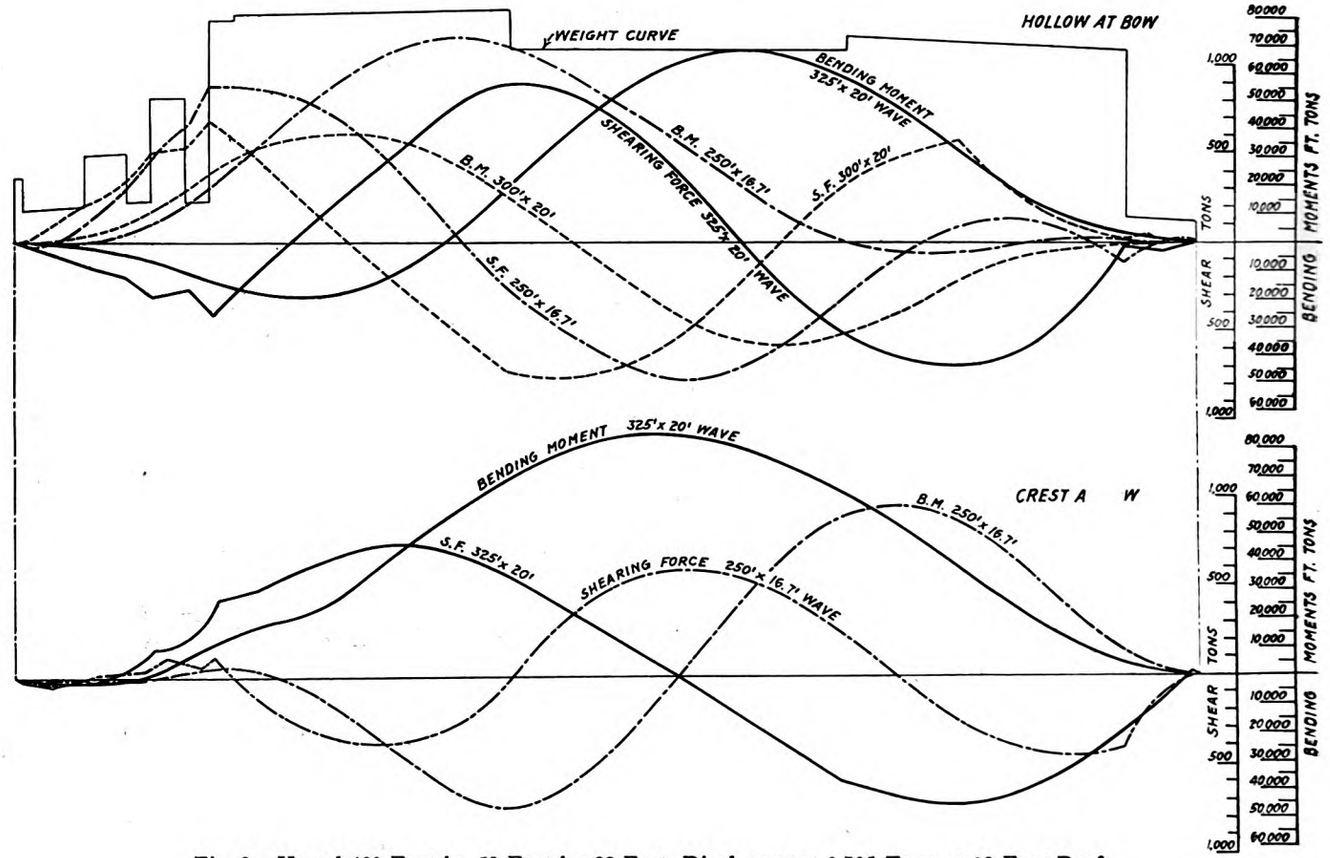

Fig. 2.—Vessel 420 Feet by 52 Feet by 28 Feet, Displacement 9,735 Tons at 19-Foot Draft

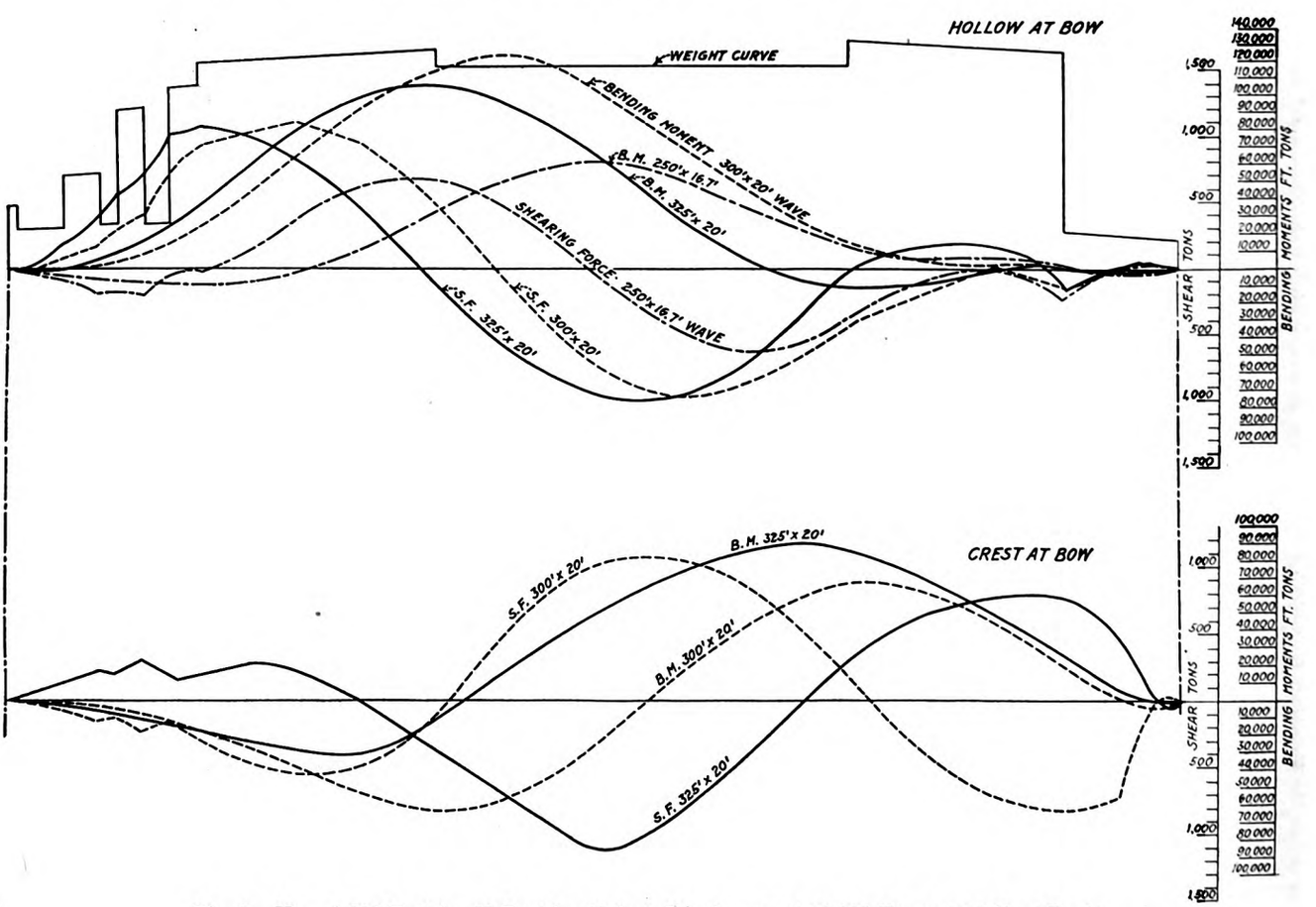

Fig. 3.—Vessel 504 Feet by 56 Feet by 30 feet, Displacement 13,025 Tons at 19-Foot Draft

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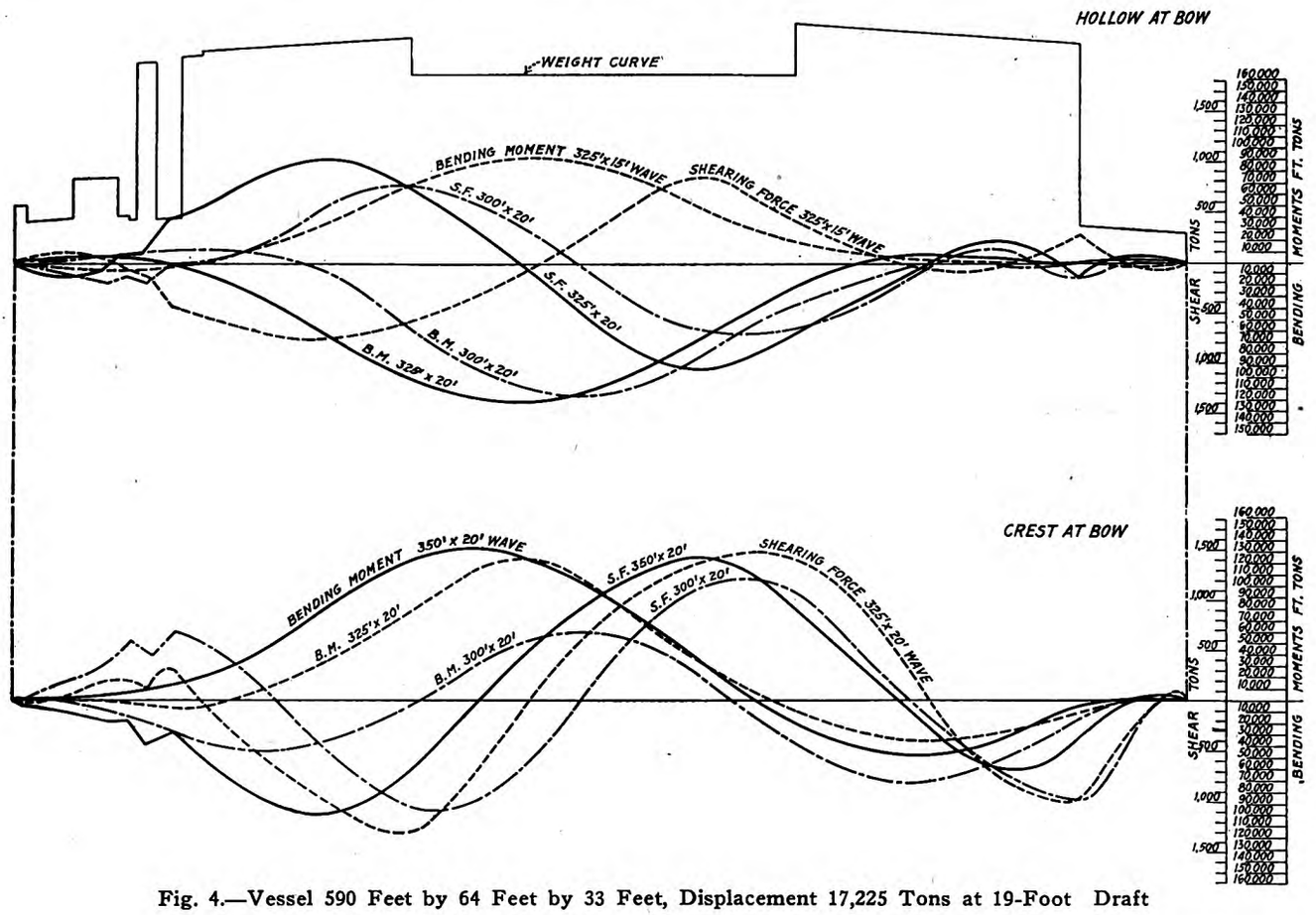

Fig. 4.—Vessel 590 Feet by 64 Feet by 33 Feet, Displacement 17,225 Tons at 19-Foot Draft

on Freeboard, as representing the strength, *viz.*, $\frac{I}{y}$ = f. d. B., the following may be developed:

If s = stress, BM = bending moment, Δ = displacement, C = bending moment factor, and C_b = block coefficient:

$$\frac{I}{y} \times s = BM = \frac{\Delta \times L}{C},$$

$$\text{f. d. B.} \times s = \frac{\text{L. D. d.} \times C_b}{35} \times \frac{L}{C};$$

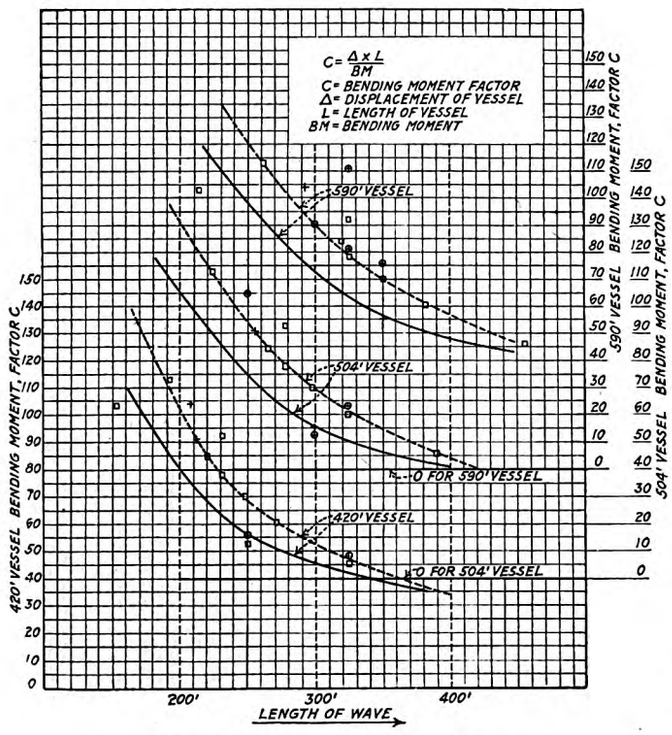
C = Δ x L / BM
C = BENDING MOMENT FACTOR
Δ = DISPLACEMENT OF VESSEL
L = LENGTH OF VESSEL
BM = BENDING MOMENT
590' VESSEL
504' VESSEL
0 FOR 590' VESSEL
420' VESSEL
0 FOR 504' VESSEL
420' VESSEL BENDING MOMENT, FACTOR C
590' VESSEL BENDING MOMENT, FACTOR C
504' VESSEL BENDING MOMENT, FACTOR C
LENGTH OF WAVE

Fig. 5.—Bending Moment Factors

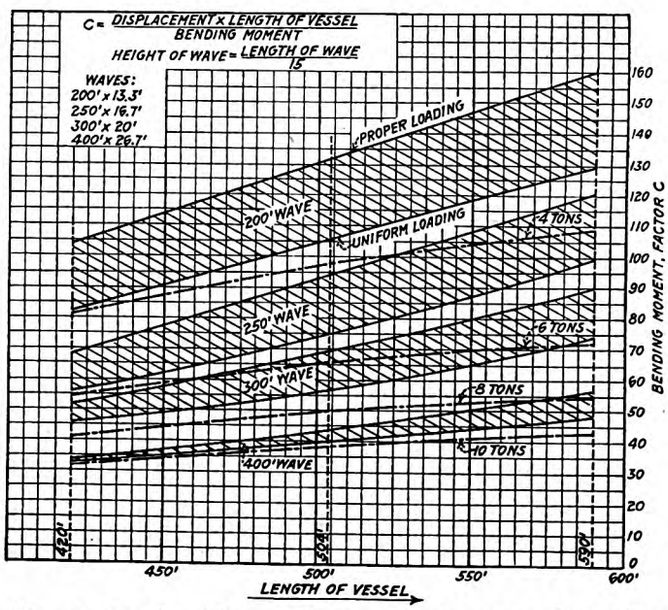

Fig. 6.—Bending Moment Factors and Corresponding Fiber Stresses

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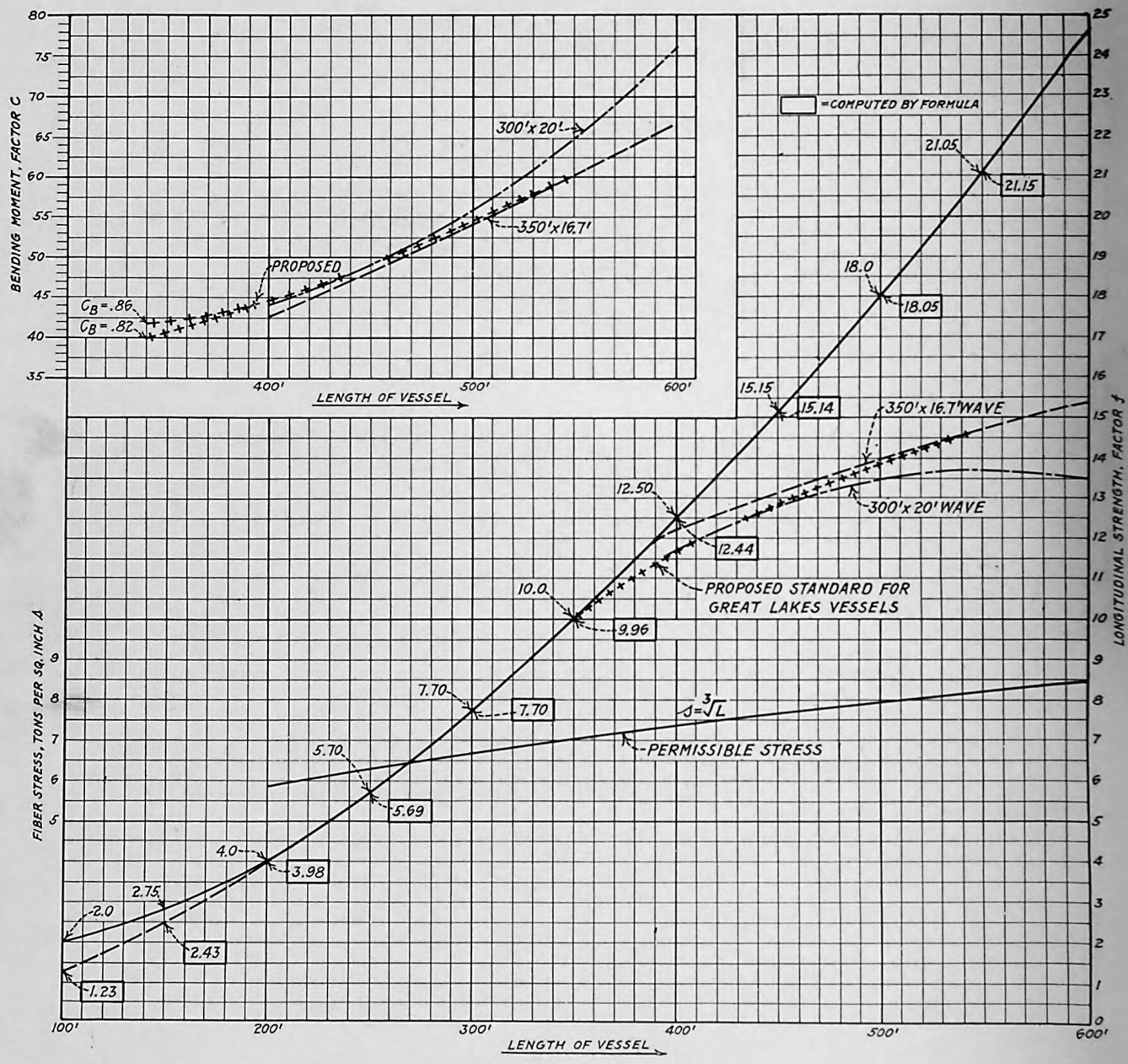

Fig. 7.—Standard of Strength

Definitions: $\frac{I}{Y}$ = f x d x B, where I = longitudinal modulus of resistance; f = longitudinal strength factor, d = draft of vessel, B = breadth of vessel; $f = \frac{C_B}{C_{UB} \times C} \times L^{5/3}$, where C_B = block coefficient, C_{UB} = cubic feet of water per ton (35 for salt and 36 for fresh water), C = bending moment factor = $\frac{\text{displacement} \times \text{length}}{\text{bending moment}}$, L = length of vessel; f = 0.000573 $L^{5/3}$, for salt water, if C_B = 0.78 and C = 39; $f = \frac{0.0239\ L^{5/3}}{C}$ for fresh water, if C_B = 0.86.

and if we assume $s = \sqrt[3]{L}$,

$$f = \frac{C_b}{35\ C} \times L^{5/3} \text{ for salt water}$$

$$= \frac{C_b}{36\ C} \times L^{5/3} \text{ for fresh water.}$$

The proposed values of f are shown on Fig. 7. It is obvious that if the waves on the Lakes do not exceed a certain definite length, the value of f should show a falling off after this length is reached. This is indicated on the curves, and it is interesting to note that numbers of the present vessels, especially the larger ones, show an excess of the above values; or, in other words, from a strength point of view, they could be loaded deeper than the present depth of water available allows.

In conclusion, and in light of the above investigations, it appears that the lake freighters of today are, for their service, as strong as, if not stronger than, similar ocean-going types, and the statement that these vessels are weaker is not borne out by theoretical investigation or practical operation.

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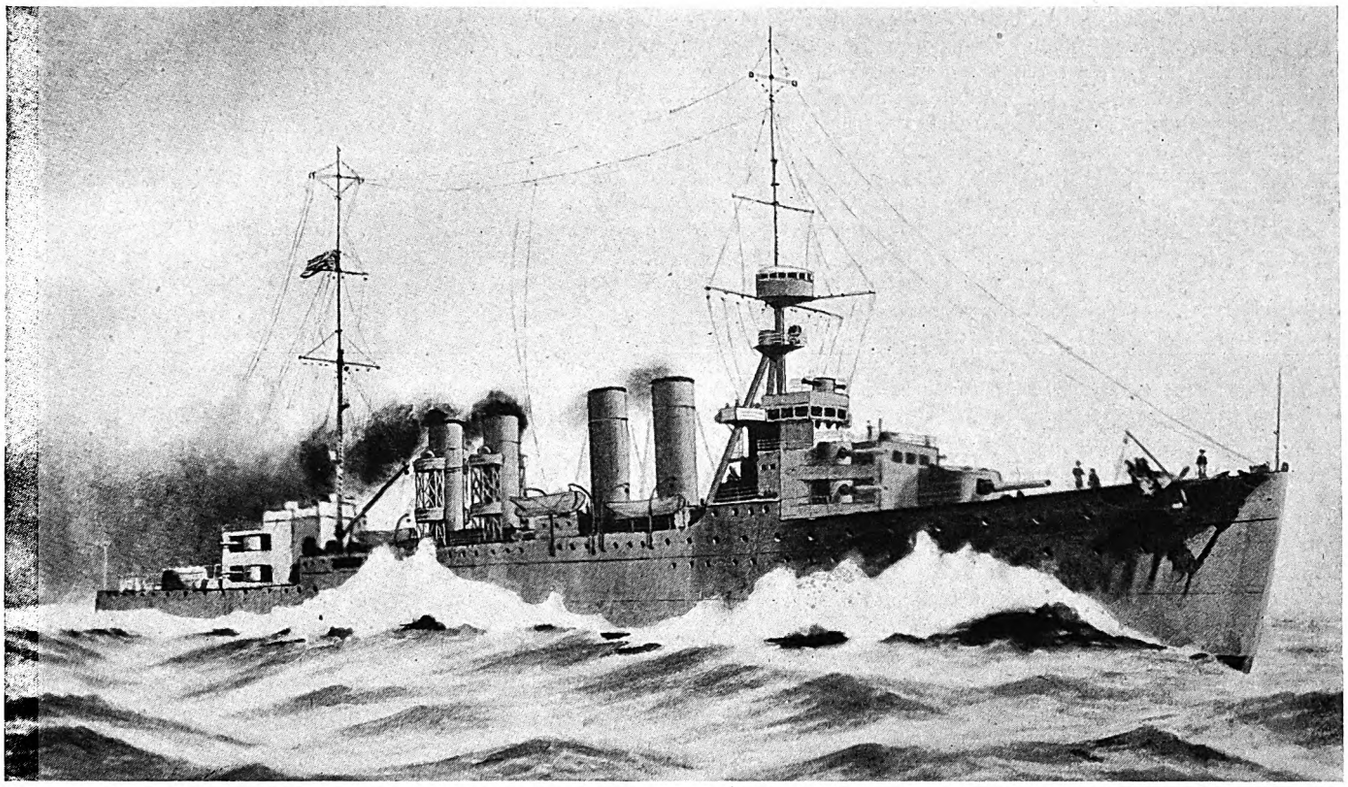


Scout Cruiser Omaha, the Highest-Powered Vessel Flying the American Flag. She Is Propelled by 90,000-Horsepower Westinghouse Turbines and Has a Maximum Speed of 35 Knots

Trial Run of Navy's Highest Powered Cruiser

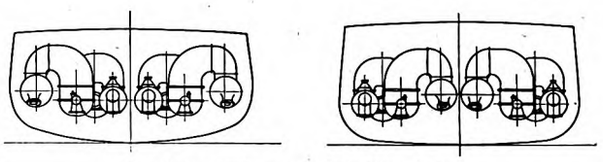
Thirty-Five Knot Vessel of Only 7,500 Tons Displacement is Propelled by Westinghouse Turbines of 90,000 Horsepower

THE United States Navy Trial Board convened on January 30 at Tacoma, Wash., to supervise the preliminary acceptance trials of the scout cruiser *Omaha,* the highest powered vessel ever built for the United States Navy.

The *Omaha* was built at the plant of the Todd Shipyards Corporation and is the first of ten vessels of her type to be ready for her tests. The trial run was over the Vashon Island course in Puget Sound and lasted over a period of six hours.

These new cruisers are comparatively a new type, at least as regards steaming radius and high speed. The most noticeable features of the designs as compared with contemporary navies are their high speed of 35 knots, their displacement of 7,500 tons and their batteries of twelve 6-inch guns. They are practically exaggerated destroyers, for with a beam of 55 feet and a mean draft of 13 feet 6 inches, they are 556 feet in length overall, giving a ratio of beam to length of one to ten.

A remarkable feature of the *Omaha* is the enormous power of the four Westinghouse turbines that propel her. When



Sections Through Engine Room

operating at full capacity, these engines will develop a total of 90,000 horsepower. Never before, on land or sea, has so large an amount of power been installed in so small a

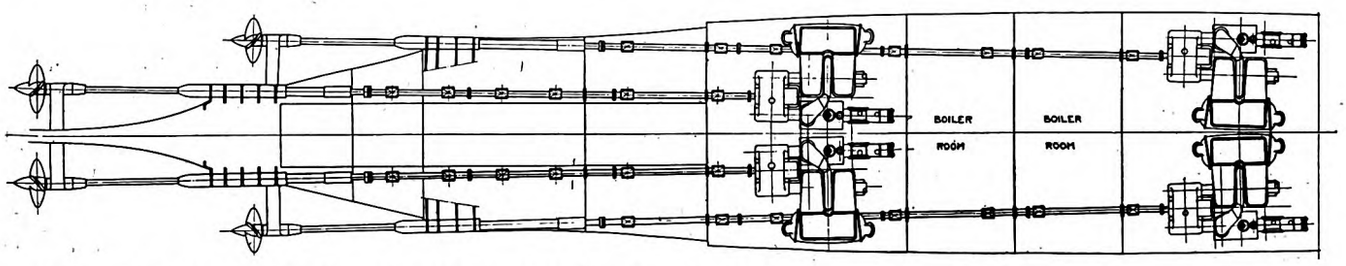


Diagram of the Omaha's Propelling Equipment, Showing the Compact Arrangement of Her High-Powered Turbines

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space. The turbines of the *Majestic,* the largest steamship in the world, develop 100,000 horsepower, but the *Majestic* is nine times larger than the *Omaha;* while the *Olympic,* which is seven times larger than the scout cruiser, is propelled by engines of only 60,000 horsepower.

However, the *Omaha* needs 90,000 horsepower only when she is tearing through the water at the express-train rate of 35 knots, or 42 miles an hour. For ordinary cruising speeds of from 12 to 15 knots, a few thousand horsepower is amply sufficient. In order to avoid operating her big engines at so small a fraction of their rated capacity, four small cruising turbines are provided. These cruising turbines can be coupled to the propellers when desired and drive the ship at the low speeds with excellent steam economy.

An interesting novelty, at least in the United States Navy, is the adoption for the first time of the tripod mast, at the head of which is located a closed director-fire position, from which the fire from the battery of twelve 6-inch guns will be controlled. A second battery will consist of two 3-inch fifty calibre air-craft guns and two three pounder saluting guns. The vessels will carry two 21-inch twin torpedo tubes which will be located on either beam on the main deck between the aftermost funnel and the main mast.

J. S. Milne, chief engineer of the Todd Shipyards Corporation, who witnessed the trial run, said that no date has yet been set for the trials of the *Milwaukee* and *Cincinnati,* the two other scout cruisers built at the Todd yard.

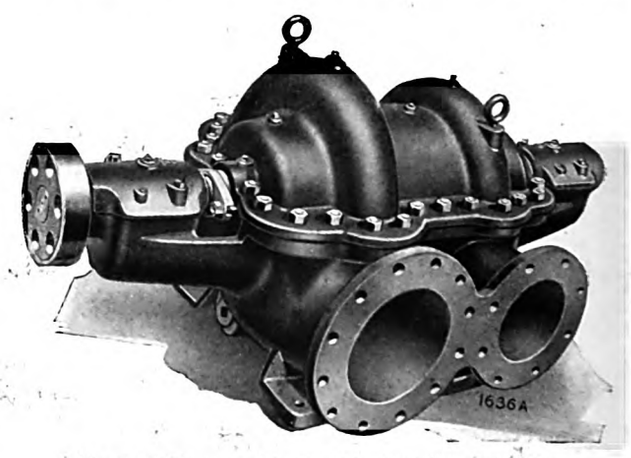
A New Type of Multi-Stage Centrifugal Pump

WHERE pumps driven by motors of slow or moderate speeds must deliver water at pressures higher than are desirable or practicable for a single-stage pump, instead of using a single-suction multi-staged pump, two separate single-stage pumps are sometimes connected in series, so that one discharges into the suction of the other. In medium and smaller sizes, the use of two independent pumps in series becomes somewhat more cumbersome, and a multi-stage pump is more often used. The length of shaft permissible in a multi-stage pump is limited because of the critical speed, and if many stages are employed, the designer no longer has a free hand in providing water passages of the shape and size conducive to the highest efficiency. Consequently, where more than three stages are required, the single suction impeller, which occupies less space on the shaft than does the double suction impeller, and thus permits the use of a shorter shaft, is used.

However, it is not possible to obtain as high efficiencies with a commercial multi-stage single-suction pump as would be possible in a single stage pump with double suction impellers, not only because of the less favorable limitations imposed on the impeller, but also because there is not sufficient space for an efficient volute diffusor and suitable return passages leading from the diffusor to the eye of the succeeding impeller. The De Laval Steam Turbine Company therefore developed a new type of multi-stage pump, known as a "series" pump, in which the advantages of the double suction impeller are retained. This is made possible by the use of a specially formed casing which provides individual volutes for each impeller, with ample interconnecting passages within the casing itself.

The double suction impeller gives perfect hydraulic balance and two of the stuffing boxes which would be required if two separate casings were employed are eliminated, together with their friction. As compared with a single suction impeller, the double suction impeller has a smaller suction eye, which permits of making the impeller itself smaller in diameter, and hence the pump can be built to operate at a higher speed for a given head and capacity, or for the same speed, head and capacity, a higher efficiency is obtained. Besides giving the highest efficiency, the volute type diffusor is superior to diffusion vanes, in that it is not subject to clogging or rapid wear, and it also gives a broader efficiency curve, that is, a higher average efficiency over a wide range of delivery.

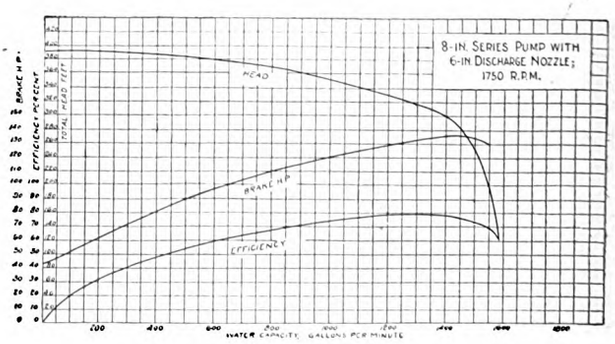
The pump casing is made in two parts, divided on a horizontal plane passing through the centerline of the shaft, the suction and discharge openings being in the lower part, so that they are not disturbed when the casing cover is lifted. Perfect form and smoothness in the suction and discharge



"Series" Pump with Double Suction Impeller

chambers and the passages connecting the volute of one stage to the suction chamber of the succeeding stage is secured by the use of dry sand molds in casting the casing and the cover.

Leakage from the discharge chamber of each impeller back to the suction chamber of the same impeller is prevented by the use of labyrinth wearing rings. One ring of each pair, known as the case protecting ring, is held in a recess formed in the casing and the casing cover. The other ring, known as the impeller protecting ring, is screwed onto the impeller. The intermeshing grooves of the labyrinth rings present a



Performance of 8-Inch "Series" Pump

long and tortuous path to water leaking from the discharge to the suction chamber, thus greatly reducing leakage while at the same time permitting the use of amply large running clearances. One proof of the effectiveness of this device in preventing leakage is the much longer life of such rings as compared with ordinary flat wearing rings.

The success attained by the series design in improving effiiency is shown by the accompanying chart. The efficiency curve is remarkably flat, that is, a high efficiency is maintained over a wide range of delivery. The advantage in this respect of the single-stage volute pump is now extended to multi-stage pumps of two and three stages.

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Stability of Large Ships*

Comparison of G.M. When Ship Enters or Leaves Port and When at Sea

By Sir John H. Biles, K.C.I.E., LL.D., D.Sc.

BEFORE the contracts for some new ships were placed, my advice was asked as to the amount of G.M. (metacentric height) which should be provided for in the light condition. I suggested one foot as a proper amount —not that a less amount would not have been satisfactory, but that experience had shown that during the process of building, additions were likely to be made which would tend to reduce the amount in that condition. Many ships have G.M. in the light condition zero or negative, and are satisfactorily worked.

Obviously, the reliable method of determining the sufficiency of the stability of a ship is to compare the amount which she may have in any condition in which she is likely to be, with that which satisfactory ships doing the same kind of work actually have. The recognized method of comparison is to find the G.M. in two conditions—first, the load condition, *i.e.* with coal, stores, passengers, baggage, mails, fresh water and cargo all on board. This corresponds to the state the ship will be in at the beginning of a voyage. The second is the arrival condition, in which coal, stores and fresh water have been nearly all consumed, and such water ballast added as may be found by experience sufficient to enable the ship to be satisfactorily worked.

Stability of a Ship on Entering or Leaving Port

There is no doubt about the weights of any of the things carried in the ship, except the cargo, which is of such varied character and quality that it is difficult to predict what its weight will be before it comes alongside the ship, and is not easy to determine even when it is there. The recognized method of allowing for cargo weights is to assume that they will be sufficient to load the vessel to her load waterline, and that the center of gravity of the weight will be at the center of gravity of the volume of the compartments of the ship which are devoted to cargo. Upon this assumption the G.M., in both leaving and arriving conditions, can be determined.

The assumption is believed generally to be on the safe side, because it is the general practice, where cargoes are varied in character, to put those of the heavier kind below. It is also frequently found in practice that general cargoes do not fill the cargo spaces, as the parts vary in size so much that it is quite impracticable to fill the spaces up to the beams. The consequence is that the centers of gravity of the cargo in the different compartments are all below the centers of the spaces, and the center of gravity of the ship and cargo is lower than the calculation shows.

Judged by this method, it may be found that a projected ship has as much or more G.M. in the load condition as many other large steamers. In the arriving condition, there may be special conditions in the ports of arrival that make comparison with steamers other than those trading to that port of little value. In some cases the margin of draft is so little that a small inclination of the ship will cause an increase of draft sufficient to cause her to touch the ground at the bilge. To determine the minimum amount of stability, it is necessary to know to what angles similar ships heel in entering the port; what their arriving drafts are; what amount of increase of draft is associated with definite angles of heel. Such information is not always available, but it is desirable that it should be obtained, and the results interpreted.

It is, however, of interest to compare the two conditions of the ship in which she will have to be in when leaving and arriving in port. They are (1) the fully laden condition when leaving, and (2) the arriving condition after having crossed the ocean. The most unfavorable condition on leaving port, so far as liability to touch the bottom is concerned, is that when the ship is fully laden and is loaded with a cargo which will, in addition to filling the ordinary hold spaces, also fill the portable passenger spaces which may be used for cargo and the reserve bunker with cargo if this is so used. A special case has been taken by way of illustration. In this condition, which we may call (1), the vessel will leave with a G.M. of, say, 2.2 feet. If the ship does not incline, the draft at which she leaves the wharf will be the maximum draft which we need consider, and it may further be noted that in the case chosen a heel of 2 degrees on either side will not increase the draft, but for every additional 1 degree of heel, the draft will be increased by about 6 inches. In the case of the ship arriving at the port, there are two conditions, (2), when the ship arrives with a cargo of about 2,000 tons' weight, and with about 1,000 tons of coal in the bunkers. In this condition, the ship will have a draft of 26 feet 3 inches and a G.M. of 1.8 feet. The other unfavorable condition, (3), is when she arrives with a small quantity of cargo, say about 700 tons, in which case she will have a draft of 24 feet 10 inches and a G.M. of 1.3 feet. Whatever the disturbing cause may be which heels the ship, we can compare the relative effects in these three cases, (1), (2) and (3), and though the information may not be available to say to what angle the ship will heel, it can be seen what are the relative effects upon the increase of draft, due to any assumed disturbing cause.

The following table shows the degrees of inclination and actual drafts for the three conditions, (1), (2) and (3), due to a series of disturbing causes, which in succession will heel the ship in condition (1) to the number of degrees named in the column headed (1). The number of degrees in the columns headed (2) and (3) are the corresponding inclinations that the ships will have for the same disturbing cause.

	(1)	(2)	(3)
Degrees of inclination	5.0	6.0	8.4
Draft in feet	30.0	28.3	28.1
Degrees of inclination	10.0	12.0	16.8
Draft in feet	32.7	31.5	32.5
Degrees of inclination	13.0	15.6	20.0
Draft in feet	34.2	33.3	34.2

From this table it will be seen that in all cases the draft of the ship arriving is not more than that of the ship leaving.

Even in the case where the ship is inclined to the greatest angle, that of the ship leaving port is not less than the others.

It seems unlikely that there can be disturbing causes which could give the ship so much heel, because, if there were, other ships would have been heeled to similar angles, and their drafts would have been increased by about the same amount. If they had been, these vessels would have

*Paper read before the Institution of Naval Architects.

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touched the bottom, and the case of the chosen vessel would be no worse than has been the case with them. If they have not touched, then the disturbing cause sufficient to make them touch cannot exist, but in none of the cases does it appear that any advantage would be gained in endeavoring to increase the stability of the ship by adding ballast to the ship or in any other way to avoid touching the bottom. The draft would be increased by the amount of the ballast, and in practically all cases the ship in the arriving condition is safer from touching than the ship in the leaving condition. It does not, therefore, seem to be desirable in the instance chosen to add ballast to the ship on account of the port conditions. Each case may have to be investigated on its merits, but a similar method of investigation should be followed.

The only other question which need be considered in the matter of the stability is that of the heeling of the ship, due to the action of the rudder, when she is in smooth water, and the effect that this heeling will have upon the minds of the passengers. No heeling is likely to be produced which can be dangerous to the ship. But a tender ship arriving in port is very likely to have heeling and oscillations set up under rudder action. There is no doubt that some passengers do not understand why a ship should incline and oscillate in smooth water, but oscillation by itself has no terrors for them, because when at sea in comparatively smooth water and with some small swell on, the vessel will roll for days to degrees of inclination of about an average of 5 degrees, with a maximum of 10 degrees, and the passengers take no notice of it. It seems, therefore, difficult to believe that anyone will be deterred from crossing in a ship on account of the tendency to roll in smooth water, under the rudder action, but the reputation of a ship for stability has to be carefully guarded, and it may be worth while to err on the side of large rather than small G.M. to avoid throwing doubt on a vessel's stability.

If the chosen vessel is in no respect different from other ships of the same class, and there has never been any question as to the safety of such ships at sea, with a G.M. as small as the chosen vessel is likely to have, no water ballast need be added to prevent the vessel from touching when rolling during entering port. It seems, therefore, desirable, before adding water ballast, to very carefully consider the above facts and arguments, and to gain further experience with the ship, before attempting to reduce her draft in the inclined condition by adding water ballast when entering port.

Stability of a Ship at Sea

The stability of a ship at sea may be considered from two points of view, first, safety; second, comfort of passengers.

Safety.—By this is meant freedom from liability to capsize. The tendency to return to the upright is the measure of the stability. The causes which move the ship from the upright are (*a*) the action of the sea, (*b*) the action of the wind, (*c*) the shifting of weights inside the ship so that the center of gravity of the whole ship and her loading are not on the middle line and (*d*) the action of the rudder, about which it is not proposed to say more.

(*a*) *The Action of the Sea.*—This produces rolling when the sea is not directly ahead. The worst case of rolling is when the period of the waves and the natural period of the rolling of the ship are nearly the same. The natural period of rolling of a ship is what she would have if inclined to some appreciable angle in still water and released from it and allowed to oscillate. The period of the largest Atlantic ocean waves, those of 500 to 600 feet long, is 10 to 11 seconds. The period of a complete oscillation of a large Atlantic liner is about 20 seconds. The period of a ship varies as the beam and inversely as the metacentric height, so that the broader the ship and the smaller the metacentric height the longer will be the period of roll of the ship and the less will the waves tend to synchronize with and therefore increase the rolling of the ship. Hence, small metacentric height is conducive to small rolling, and so far as the action of the sea alone is concerned, is conducive to safety.

(*b*) *The Action of the Wind.*—The wind produces the greatest heeling effect when blowing broadside on, and if it has continued for long in that direction will have raised a corresponding sea which will tend to roll the vessel. The wind tends to produce a mean inclination of the ship, and she will tend to oscillate about this mean inclined position. Suppose, for instance, the ship has a mean steady list of 10 degrees due to the wind, and that the action of the sea alone would cause her to roll 10 degrees on each side of a vertical line, she will roll when under the action of the wind to approximately 20 degrees to leeward of her own upright position. As only large waves can make a large ship with a small G.M. roll to large angles by synchronization, it is evident that generally it is better to have a ship with a small metacentric height which will therefore roll little, though that little may be about an inclined axis, than one with a large metacentric height which will roll to great angles about a less inclined axis.

The real question is what smallness of metacentric height is permissible; in other words, to what angle a ship may be allowed to heel under a steady wind pressure in order that her rolling may be reduced, so that the maximum angle to which she inclines shall be the least. Take an example of a ship with, say, 2½ feet of metacentric height which under a wind pressure of, say, 8 pounds per square foot in a heavy gale, force 9 to 10, would incline to a steady angle of 5½ degrees. Such a ship would have a period of oscillation of, say 20 seconds. If this ship's metacentric height be decreased to 1¼ feet she would have a steady heel about 11 degrees and her period would be increased to 28 seconds.

If the 20-second period would cause her to roll at least 5½ degrees (the difference between 5½ degrees and 11 degrees) more than the 28-second period ship, her maximum angle of roll to leeward would be more than that of the less stable ship. The motion of the 28-second period ship would be much slower than that of the 20-second period ship. The disadvantage of a greater mean inclination would exist in the less stable ship. Generally, there would be less liability to rolling in the more tender ship, so that the disadvantage of the greater mean inclination might be more than balanced by the advantage of the reduced frequency of rolling and the reduced maximum angle of rolling. It is therefore evident that for a steady wind the reduced stability may, on the whole, in this case, be an advantage. When we consider winds of exceptional force such as forces of 11 and 12, the mean angle of inclination may be undesirable, and it may be desirable to alter course sufficiently to reduce the heeling effect of the wind in the tenderer ship, but this is a very exceptional condition which can be met with safety.

The effects of gusts of wind of great force acting upon a ship when rolling have received some consideration. It has been assumed that it is possible, under very exceptional circumstances, for a ship to roll through 20 degrees on each side of the upright, and that when rolling to windward through 20 degrees she may at the end of a windward roll be struck by a squall of extreme violence which would, by its continued force and by the action of the roll from windward, cause her to roll to a much larger angle to leeward. To estimate the effect of such a combination of circumstances is not easy. The effect of resistance to rolling through large angles is not easy to estimate, but it is known to be very considerable, and if the roll to leeward due to the squall should be 30 to 40 degrees, the total roll would be 50 to 60

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degrees, including the 20 degrees from windward. This roll would take place in less than 10 seconds and the velocity of oscillation would be very high. The effect of the wind pressure acting on the surface of a ship is not easy to determine. It can be calculated on an assumption as to the wind pressure on the surface in terms of its area and angle of inclination, but these assumptions may not be accurate. The only thing that seems to be possible is to compare the rolling of ships under such assumed circumstances, and to compare ships on such assumptions, which have for years successfully withstood the storms of the ocean, with any untried ship whose safety it is desirable to estimate.

This has been done in the case of four ships, of which A, B and C have been on service, and D, which is untried. Taking them all in the same conditions as to lading, with a light cargo and in a spent and ballasted condition at the end of a voyage, it is possible to make a comparative estimate *disregarding resistance to rolling*, which is very large, but proportionately the same in all the vessels, and assuming the wind pressure to be proportional to the area exposed to the wind (force 10), the results are as follows:

A	32.5 degrees
B	39.5 degrees
C	33.5 degrees
D	37.5 degrees

This result is reached by equating the area of the wind moment curves from 20 degrees to windward to the angle on the curve of stability which includes the same area.

To take account of the resistance to rolling in such ships as these is not very easy. The method of doing so is to assume coefficients of resistance which are based upon experiments made upon ships which have been rolled in smooth water by moving weights across the ship in time with the rolling so as to gradually increase the extreme angle reached. Very few ships have been rolled: and these are nearly all warships. The angle reached has not been very great, nothing like the angles reached at sea when rolling under the action of waves. The laws governing the action of bilge keels in rolling are not fully known on account of the difficulty of carrying out systematic experiments on a large scale to verify any hypotheses. The best that can be done at present is to choose coefficients of resistance from the nearest suitable ship upon which experiments have been made.

H.M.S. *Revenge* was rolled in smooth water by swinging her turrets and running 300 to 400 men across the ship synchronously with the ship. She was rolled without headway and also at speeds of 10 and 12 knots. The bilge keels were 200 feet long and 3 feet deep, tapering at the ends, the actual area for both bilge keels being 1,170 square feet. The center of the keels was 41 feet from the center of gravity of the ship. The dimensions of the ship were: Length 380, breadth 75, draft 27 feet 6 inches; displacement 14,300 tons. The period of a single swing was about 8 seconds, that is, 16 seconds for a double swing. The metacentric height was about 3¾ feet.

The results of the experiments on the *Revenge* may be used for approximating to the resistance to rolling of ships like A, B, C and D, which are ships of about the same order of beam and draft. It will also be possible to compare ships such as these with other vessels of large dimensions which have been running in all kinds of Atlantic weather for many years.

If the resistance to rolling be neglected a comparison between ships having similar elements of resistance such as bilge keels can be made which, while not giving the actual angles to which the ships will roll, will give a means of comparing new ships with those that have successfully withstood the storms of many years. But we may approximate by using the experiments on the *Revenge* to the effect of resistance and see whether the comparative results are much affected by this resistance. When this is done it must not be assumed that the reduced angles of roll so determined are accurate. They will, as before, only give a comparison of new vessels with old and successfully tried ones. The assumptions which have to be made in order to obtain comparative quantitative results of considerable magnitude (and it is of little use to consider only cases in which the rolling angles are small) must necessarily be only assumptions, and may not represent the actual facts of the case. But they will afford a comparison which for somewhat similar ships ought to enable us to form an opinion on the safety of new ships. On the same assumptions as those already made when resistance to rolling was neglected, *viz.* being struck by a squall, force 10, when at

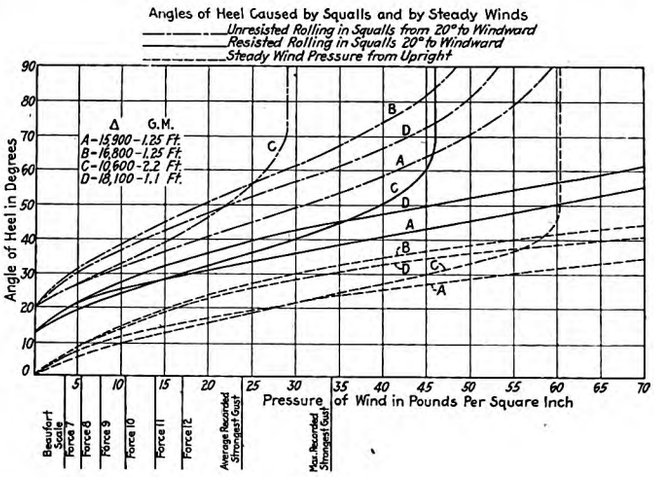

Fig. 1

20 degrees to windward, the resistance has been approximately calculated with assumed pressures of wind, the angle reached being as follows:

A	25 degrees
C	24½ degrees
D	27½ degrees

B is so near to D that the results have not been worked out. It seems from these results that there need be no apprehensions of the safety of D.

Another instance has been taken which is of comparative value. The vessels E, F, G and H are vessels which have been successfully crossing the Atlantic for from twenty to twenty-five years. They are not dissimilar in dimensions, being 63 feet beam and 28 feet draft, but being much older have less lofty deck erections. The determining factors are the exposed area of side and the maximum righting moment of the curve of stability. In these respects these four vessels are very similar to each other. The case of one, E, has been taken. The inclining effect of the wind pressure is about one-half that of D. Neglecting resistance to rolling it is found that a wind pressure of about 32.7 pounds per square foot would bring E to a condition in which she would reach an angle of roll of about 70 degrees under the same assumptions as to weather roll and leave her with practically no margin of stability, so that a little higher wind pressure would completely overset her. In this condition, D would reach 58 degrees and would have a considerable margin of stability so that she could receive a considerable increase of wind pressure without oversetting. It may therefore be safely assumed that D is at least as safe as E which has for over thirty years successfully continued to run. If we take account of resistance to rolling, the comparison is still better for the ships with bilge keels,

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for the four ships E, F, G and H have no bilge keels, and it was demonstrated in the case of the *Revenge* that the resistance to rolling due to bilge keels is such that at comparatively small angles the angle of roll without bilge keels was about three times what it was with bilge keels. In the case of D, if resistance be taken into account, a 32.7 wind pressure will incline her in a squall to 43½ degrees, while E would probably incline to 60 degrees.

It seems, therefore, that there need be no fear for the safety of D.

(*c*) The third cause which has to be considered is that of shifting the center of gravity of the ship by shifting weights inside her. If the vessel rolls to the large angles, there will be a tendency to shift fuel and cargo. There can be little chance of shifting coal, because in the condition of loading assumed there is but a small quantity of coal left, and this generally will be in the side bunkers which will not permit of much shifting. In other conditions of loading, such as the reserve bunker being partially filled, there is not much chance of coal shifting, as the firemen's passage or some other longitudinal division is in the ship, but the center of gravity of the ship will be lower and the stability greater. Loose water or oil may cause shifting of the center of gravity of the ship, but tanks are usually well divided, and it is usual to empty a tank before beginning to broach another. This should be done as a matter of routine. Where practicable the lee tank should be emptied before the corresponding weather one. The free surface of a tank partially filled tends to set up oscillations which tend to neutralize the effect of inclination. The shifting of cargo is possible, but with ordinary precautions in loading this is not likely to occur. In the case of grain cargoes the trunks leading to the holds will necessarily be well filled to provide feeders for the sinking of the grain. The hatches of the decks below on the trunks should be left off to allow the grain to flow through them as it settles. Special instructions for stowing the grain to avoid the chance of shifting should be systematically given effect to. With these precautions there should be no chance of any appreciable shift of coal or cargo in these vessels.

In the case of heavy rolling due to unusually great wind pressures, it will naturally suggest itself to the master of the vessel to alter course so as to avoid the effects of the abnormal wind pressures. These cases will occur too seldom to appreciably interfere with the successful running of the ship.

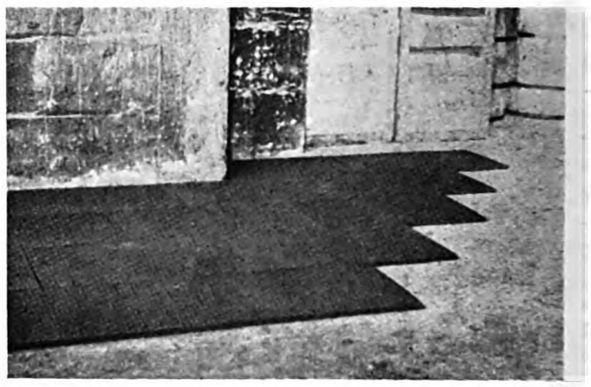
The comfort of passengers in rolling is dependent largely on the maximum angle of roll and the period in which this angle is rolled. Those who have been to sea in quick rolling ships, especially if the ships are rolling through large angles, are familiar with the great acceleration which their bodies experience, especially on the top decks far distant from the center of motion. In clear transverse spaces in broad ships the effect of this acceleration is to cause them to find difficulty in holding on to some fixed part of the ship, and if they do not happen to have something to hold on to they will find the operation of being stopped fraught with risk of knocks and possibly bruises. Hence, it is desirable to provide long periods and small angles of roll for the comfort of the passengers.

The question of the relation between the effect of the wind pressure on modern high-sided ships and the metacentric height is one deserving of the most careful consideration. The curves shown on Fig. 1 give the angles of heel of the ships A, B, C, D, under wind pressures acting steadily or in squalls. The angles of heel are given in the cases when resistance is and is not taken into account.

No attempt has been made to determine the angles of roll due to the action of the sea. This subject is best treated experimentally. To those interested a summary of the general question of rolling given in my Presidential Address to the Engineering Section of the British Association in 1911 (see *Transactions* of Section C, British Association Meeting at Portsmouth, 1911) may be usefully consulted.

Fiber Flooring for Ship Decks

A NEW type leather and asphalt composition flooring for ship, industrial and office service is being marketed by the James A. Coffey Engineering Corporation, New York. The flooring is made from strips of scrap leather impregnated and bonded in asphalt by a large shoe manufacturing concern as a by-product. It is laid in

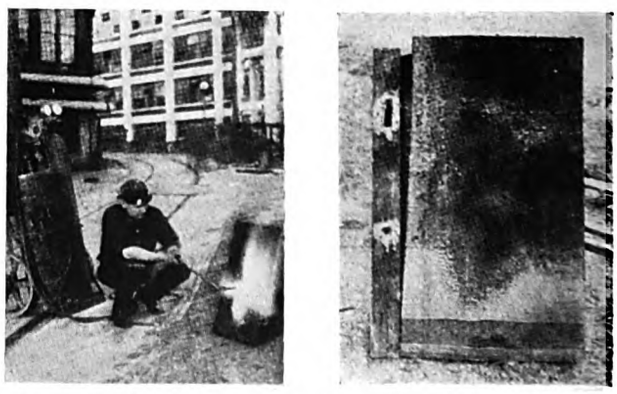


Fiber Flooring Is Laid in Asphalt in Sheets 16 by 28 Inches

sheets, 16 inches by 28 inches, and weighs less than four pounds per square foot.

This flooring can be laid over any surface and is ready for use as soon as put down. It can be used as a finished flooring or decking or as an under flooring or decking on ships where it is bonded to the deck and stops the corrosion of steel. Composition, linoleum, rubber and cork tile can be laid over the flooring. The combination of leather and asphalt gives a resilient, noiseless and slip proof surface.

Service tests have been carried out on this flooring over



An Oxy-Acetylene Flame of 6,000 Degrees F. Merely Scorches Fiber Flooring to a Depth of ¼ Inch

a period of three years during which time it has been subjected to heavy traffic, heat tests, foot wear and other methods of use to determine its wearing qualities. In the course of the tests, samples of this flooring were exposed for two minutes to the flame of an oxy-acetylene torch and even under the resulting temperature of 6,000 degrees F. were charred only to a depth of ¼ inch without flaming. It was also laid in drying rooms where it was exposed to a constant heat of 300 degrees F. without deterioration.

The special features claimed for the flooring are that it is a non-conductor of heat, will not expand or contract, curl or lift, is water and slip proof, sanitary and has long life.

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Proportions and Block Coefficients of Merchant Ships*

Increased Beam an Advantage, If Depth and Draft Are Increased —Economic Proportions Dependent on Depth of Harbors

By W. J. Lovett

LLOYD'S REGISTER for 1921-22 contains particulars of about 28,500 steamers, and their analysis on a speed basis is given in Table I.

TABLE I

Speed	Not Exceeding 13 Knots	Over 13 and Under 16 Knots	16 Knots and Under 19	19 Knots and Under 22	22 Knots and Over
Number of vessels....	27,220	737	361	77	34

From these figures it may be assumed that about 3 percent of the merchant steamers of the world are engaged primarily in the passenger trade and the remaining 97 percent are cargo carriers.

An individual analysis has been made for about 700 vessels of 15 knots' speed and over. The dimensions of each were proportioned to a common length of 400 feet, and the comparative mean breadths at varying speeds are shown in Table II, omitting such special vessels as American river steamers. The analysis is given for two groups, viz., vessels of less length than 400 feet and vessels exceeding 400 feet in length.

TABLE II

	Mean Proportionate Breadths for Length of 400 Ft.			
Length	15-17 Knots Ft.	17-19 Knots Ft.	19-21 Knots Ft.	21 Knots and Over Ft.
Vessels under 400 ft.....	51.4	50.2	49.4	48.5
Vessels over 400 ft.....	48.0	47.0	46.5	44.5

It will be noted that there is a gradual reduction of beam as the speeds increase, and that the small steamers have adopted, or been forced to adopt, greater beam than the large steamers, and this increase becomes more marked when the vessels are considered on a $\frac{V}{\sqrt{L}}$ basis. The market for, or the supply of, large steamers of 19 knots or over is limited, as there are only 26 vessels of that speed over 400 feet in length, whereas there are 27 vessels under 300 feet, and 58 between 300 and 400 feet that are capable of this speed; so that the fast steamers of our mercantile navies are preponderatingly of short length. Table III has been prepared to illustrate this feature.

TABLE III

	Number of Vessels					
Speed	Under 200 Ft. Long	200-300 Ft.	300-400 Ft.	400-500 Ft.	500-600 Ft.	Over 600 Ft.
Above 23 knots.....	0	3	10	0	0	4
21-23 knots	0	6	24	0	4	4
19-21 knots	0	18	24	3	9	2
18-19 knots	1	24	17	8	15	7
17-18 knots	3	30	26	25	29	9
16-17 knots	4	53	39	38	27	6
15-16 knots	9	61	40	78	28	1
Total	17	195	180	152	112	33

A comparison is made in Table IV between a summary of Table III and a similar analysis prepared from Lloyd's Register for 1914. This shows that at present there is a shortage of almost 200 steamers of 15 knots' speed and over as compared with the 1914 returns, which means that the world's existing fleet of fast merchant steamers is 20 percent less in numbers than pre-war standard.

TABLE IV

	Number of Vessels	
Speed	1914-15	1921-22
Above 23 knots.....	23	17
21-23 knots	46	38
19-21 knots	90	56
18-19 knots	101	72
17-18 knots	125	122
16-17 knots	209	167
15-16 knots	284	217
Total	878	689

Excess of beam involves excess of power in fast vessels where the wave-making resistance is a dominant feature, but in cargo carriers the resistance is largely frictional, and dimensional proportions may be modified within wide practical limits without detriment to the propulsive efficiency. Existing cargo tonnage has a mean breadth of about 1/10L. plus 11 feet, but the published returns of recently built steamers show that the present practice favors increased beam in proportion to length, as is indicated in the list of some broad vessels given in Table V, which could be considerably extended.

For convenience of analysis the beam of each vessel has been proportioned to a common length of 400 feet.

TABLE V

Name of Vessel	Length Ft.	Beam Ft.	Draft Ft.	Draft In.	Beam for 400-ft. Length Ft.
John D. Archbold.....	555	75.0	30	0	54.1
Keystone State	518	72.0	30	6	55.6
Amsterdam	476	65.7	..	..	55.2
Almelo	447.5	62.8	..	..	56.2
Ohio	445	61.2	26	9	55.0
Nagara	430	61.3	29	4	57.0
Agwimars	429	59.2	25	7	55.2
Brielle	402	58.3	..	..	58.0
P.L.M. 20.....	400	56.0	25	1	56.0
Burgerdijk	400	54.0	30	2	54.0
Boren	377	54.0	24	2	57.3
Assiout	370	51.2	24	0	55.3
Kedoe	367	51.5	23	2	56.1
Maplemore	365	51.0	23	7	55.9
Saint René	351	52.5	24	4	59.8
Digby	350	50.0	23	6	57.1
Urd	334	48.0	21	3	57.5
Sierra Morena	331	48.7	22	0	58.8
Kielehaven	327	47.3	20	5	57.8
Victor de Chavarri.....	312	48.0	20	2	61.5
Omana	303	46.2	19	3	60.9
Sebastian	303	43.0	19	10	56.7

Separating the larger of the above vessels from the smaller ones, then, for a common length of 400 feet,

(1) Vessels 400 feet and upward have mean proportionate beam of 55.6 feet.

(2) Vessels under 400 feet have mean proportionate beam of 57.9 feet.

The *Keystone State*, a vessel of 518 feet length, has a beam of 1/10L. plus 20.2 feet.

The *Victor de Chavarri*, a vessel of 312 feet length, has a beam of 1/10L. plus 16.8 feet, and the *Nagara*, a vessel of 430 feet length, has a beam of 1/10L. plus 18.3 feet.

The depth of water available at a port will determine the maximum permissible draft when entering the port, and, as all vessels entering any port are thus limited in draft, it follows that the proportions of beam to draft will vary considerably. For cargo carriers with erections extending over 60 percent of the length, the assigned freeboard draft is a fairly constant fraction of the depth and is only slightly modified by length, sheer and block coefficient. Taking the

*Paper read at the sixty-third session of the Institution of Naval Architects.

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TABLE VI—BLOCK COEFFICIENT

V / √L	Length ÷ Breadth 6.5	6.6	6.7	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3
.70	.647	.653	.659	.664	.670	.676	.681	.686	.691	.696	.701	.705	.710	.714	.719	.723	.728	.732	.737
.69	.653	.659	.665	.671	.676	.681	.686	.691	.696	.701	.706	.711	.715	.720	.724	.729	.733	.737	.742
.68	.660	.666	.671	.677	.682	.687	.692	.697	.702	.707	.712	.716	.720	.725	.729	.734	.738	.742	.747
.67	.666	.672	.678	.683	.688	.693	.698	.703	.708	.712	.717	.721	.726	.730	.735	.739	.743	.747	.752
.66	.673	.679	.684	.689	.694	.699	.704	.709	.713	.718	.722	.726	.731	.735	.739	.744	.748	.752	.756
.65	.679	.685	.690	.695	.700	.705	.709	.714	.719	.723	.727	.732	.736	.740	.744	.749	.752	.757	.761
.64	.686	.691	.696	.701	.706	.710	.715	.720	.724	.728	.732	.737	.741	.745	.749	.753	.757	.761	.765
.63	.692	.697	.702	.707	.711	.716	.721	.725	.729	.733	.737	.741	.745	.750	.753	.757	.761	.765	.769
.62	.698	.703	.708	.713	.717	.722	.726	.730	.734	.738	.742	.746	.750	.754	.758	.762	.765	.769	.773
.61	.704	.709	.714	.719	.723	.727	.731	.735	.739	.743	.747	.751	.755	.758	.762	.766	.770	.773	.777
.60	.710	.715	.720	.724	.728	.732	.736	.740	.744	.748	.752	.755	.759	.763	.766	.770	.773	.777	.780
.59	.716	.721	.725	.729	.733	.738	.741	.745	.749	.752	.756	.760	.763	.767	.770	.774	.777	.781	.783
.58	.722	.726	.731	.735	.739	.743	.746	.750	.754	.757	.761	.764	.767	.771	.774	.777	.781	.784	.787
.57	.727	.732	.736	.740	.744	.748	.751	.755	.758	.762	.766	.769	.772	.775	.778	.781	.784	.787	.790
.56	.733	.738	.741	.745	.749	.752	.756	.759	.763	.766	.769	.772	.775	.778	.781	.784	.787	.790	.793
.55	.739	.743	.747	.750	.754	.757	.761	.764	.767	.770	.773	.776	.779	.782	.785	.788	.791	.794	.796
.54	.744	.748	.752	.755	.758	.762	.765	.768	.771	.774	.777	.780	.783	.786	.788	.791	.794	.797	.799
.53	.749	.753	.757	.760	.763	.766	.769	.772	.775	.778	.781	.784	.786	.789	.792	.794	.797	.799	.802
.52	.755	.758	.762	.765	.768	.771	.774	.777	.779	.782	.785	.787	.790	.792	.795	.797	.800	.802	.805
.51	.760	.763	.766	.769	.772	.775	.778	.781	.783	.786	.788	.791	.793	.795	.798	.800	.803	.805	.807
.50	.765	.768	.771	.774	.777	.780	.782	.785	.787	.790	.792	.794	.796	.799	.801	.803	.806	.808	.810

same block coefficient, same proportions of deck erections, and same sheer ratio, then

draft = 0.83 depth for 350-foot steamer.
= 0.81 depth for 400-foot steamer.
= 0.79 depth for 450-foot steamer.

If the draft of the vessel is limited, the depth for deadweight cargoes is fixed by the addition of draft and freeboard, but where the draft is not so limited the depth is fixed by the beam, in order to give a stable vessel under ordinary conditions of lading; and as increasing the draft is the cheapest way to obtain deadweight, this vessel will be the best paying for its owner. Stable proportions of depth to breadth will vary with the erections, but assuming 60 percent of the length to be covered by erections, then a stable depth may be taken as 0.63 beam. Dealing only with two dimensions, it will not lessen the cost, if a vessel of ordinary proportions is made shorter and broader, because, although breadth is slightly cheaper to build than length, there must be a reduction in the block coefficient of the shorter and broader vessel. When, however, the adoption of the greater beam can be utilized to increase the depth, and consequently the draft, it does pay an owner to modify the dimensional proportions of his vessel, and the economical grades between the vessel of ordinary and extreme proportions are largely dependent on the permissible load draft.

The limits of present-day practice may be stated as:

Breadth = 1/10 length plus 18 feet
Depth = 0.63 of breadth
Draft = 0.81 of depth (for 400-foot length)

This gives a vessel 400 feet × 58 feet × 36 feet 6 inches and 29 feet 6 inches draft, and this maximum economic limit for hull cost of ratio of beam to draft is 1.97, but it is seldom practicable to have so deep a draft, and the mean proportionate breadth and draft of the vessels in Table IV may be stated on a 400-foot length basis as 57 feet × 25 feet 9 inches, or a ratio of 2.21 and a difference of 3 feet 9 inches in the draft. An owner is therefore prevented from going to the limit of maximum economic proportions until the available depth of water at the various ports is made suitable for the increased load draft.

The determination of the block coefficient is usually a matter of comparison with similar vessels, but the publication of various model experiment results has suggested a manner of arriving at a maximum fullness of form compatible with economy of propelling power, and presuming in all cases a well-established tank form of model. The proceedings of the technical societies in this and other countries contain records of model experiments variously set out, and in most cases made to demonstrate some definite postulate. These available results, when applicable to cargo vessels, have been plotted to Froude's (K) and (C) values, and in each case a note was taken of the (K) speed value at midway on the first definite steepening of the (C) curve, denoting an increase in resistance ratio. This frequently occurred in 400 to 450-foot vessels at a (C) value of about 0.7, so that it may almost be inferred that cargo vessels of good tank form of model have their maximum speed for economical propulsion at that (K) value where the (C) curve crosses the 0.7 value datum. Many slow-speed forms have been tried in the tank to give smaller (C) values than 0.7 at the designed speed, although in these cases it is probable that the models could have been made fuller and better paying propositions for their owners, but there is undoubtedly a distinct range or latitude of fullness or fineness, and the owner must decide whether it pays him better to have a fine model and low engine power or to have a full model and high engine power.

The block cofficients in Table VI will enable a form to be designed suitable for the speed intended, but of course a still fuller coefficient might be employed at the expenditure of an excess of power and fuel consumption, and vice versa. These block coefficients are intended to be applied to vessels having midship coefficients within the limits of 0.96 to 0.99, and lengths within the limits of 350 feet to 550 feet.

The results of detailed comparative calculations for various vessels are given in Tables VII, VIII and IX. In each table Type A is a vessel of ordinary proportions having a beam of 1/10L. plus 12 feet, and also of average draft. Type B has same draft but a beam of 1/10L. plus 18 feet. Type C has the extreme beam of 1/10L. plus 18 feet, but has the maximum depth for safe stability and the maximum draft for this depth. The depth in Types A and B have been determined by the addition of the draft and freeboard. In all cases the vessels have plain cargo boat specifications and erections covering 60 percent of the length. The comparative indicated horsepower in each case is stated, and the method of arriving at this power is given in the Appendix.

TABLE VII—6,000 TONS DEADWEIGHT, 10½ KNOTS' SPEED

Item	A	B	C
Length	357 ft.	343 ft.	319 ft.
Breadth	47.7 ft.	52.3 ft.	49.9 ft.
Depth	27.25 ft	27 ft.	31.42 ft.
Draft	23 ft.	23 ft.	26 ft. 3 in.
Coefficient	0.771	0.733	0.712
Displacement	8,630	8,630	8,500
I. H. P.	1,640	1,620	1,620
Cost of hull	100	100	93

TABLE VIII—9,000 TONS DEADWEIGHT, 11 KNOTS' SPEED

Item	A	B	C
Length	408 ft.	393 ft.	372 ft.
Breadth	52.8 ft.	57.3 ft.	55.2 ft.
Depth	32 ft.	31.75 ft.	34.83 ft.
Draft	26 ft.	26 ft.	28 ft. 7 in.
Coefficient	0.782	0.75	0.737
Displacement	12,530	12,530	12,360
I. H. P.	2,400	2,370	2,360
Cost of hull	100	100	93

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The hull cost, being chiefly dependent on the weight of steel, is comparatively shown as a percentage in all cases, and the basis figure of 100 is given to Type A vessels of ordinary proportions and average drafts.

TABLE IX—12,000 TONS DEADWEIGHT, 11½ KNOTS' SPEED

Item	A	B	C
Length	460 ft.	443 ft.	423 ft.
Breadth	58 ft.	62.3 ft.	60.3 ft.
Depth	35.25 ft.	34.83 ft.	38 ft.
Draft	28 ft.	28 ft.	30 ft. 4 in.
Coefficient	0.791	0.765	0.754
Displacement	16,900	16,900	16,660
I. H. P.	3,300	3,270	3,250
Cost of hull	100	100	94

CONCLUSIONS

In vessels of $\frac{V}{\sqrt{L}}$ up to about 0.65, and trading generally in smooth water:

(1) It is an advantage to increase beam, if depth and draft can also be increased.

(2) It is no advantage to shorten and broaden a vessel, if the draft is not increased.

(3) It is no disadvantage to increase beam, if necessary for stability.

(4) Increased beam does not involve reduced speed nor increased power nor increased cost, if displacement is unchanged.

(5) A minimum depth of channel of 32 feet should be provided at all important seaports.

Appendix

In estimating the comparative horsepowers for the vessels considered it was necessary that some simple tables should be available which would take account of the various dimensions, proportions and speeds involved. After examination, it was decided to try to extend and project the curves given in Taylor's *Speed and Power of Ships* so that they might be used for the assumed cargo vessels. This involved a series of cross curves and an alteration in the method of setting out; but the result is a direct discernment of comparative indicated horsepower for widely varying vessels, and the tables are included here in the belief that they may be of assistance to designers when comparative horsepowers are required. In their application to several known vessels of good form the horsepowers obtained from the tables have closely approximated those installed in the vessels. The formulæ are:

(1) Wetted surface $= B\sqrt{\Delta L}$.

(2) Frictional resistance in pounds $= A\,B\,C\,\Delta$.

(3) Skin horsepower = Frictional resistance $\times$ V $\times$ 0.0030707.

(4) Residuary resistance in pounds $= D\,\Delta$.

(5) Residuary horsepower = Residuary resistance $\times$ V $\times$ 0.0030707.

(6) Indicated horsepower = 2 (skin horsepower + residuary horsepower).

TABLE A—FRICTIONAL RESISTANCE FOR 400-FOOT VESSEL—POUNDS PER TON DISPLACEMENT

$\frac{V}{\sqrt{L}}$	Displacement ÷ (L/100)³						
	140	160	180	200	220	240	260
0.65	0.209	0.196	0.184	0.175	0.168	0.163	0.157
0.64	0.203	0.190	0.179	0.170	0.163	0.158	0.153
0.63	0.197	0.184	0.174	0.165	0.158	0.154	0.149
0.62	0.191	0.179	0.169	0.160	0.154	0.150	0.145
0.61	0.185	0.174	0.164	0.156	0.150	0.146	0.141
0.60	0.180	0.169	0.159	0.152	0.146	0.142	0.137
0.59	0.175	0.164	0.154	0.148	0.142	0.138	0.133
0.58	0.170	0.159	0.149	0.144	0.138	0.134	0.129
0.57	0.165	0.154	0.144	0.140	0.134	0.130	0.125
0.56	0.160	0.149	0.140	0.136	0.130	0.126	0.121
0.55	0.155	0.144	0.136	0.132	0.126	0.122	0.117
0.54	0.150	0.139	0.132	0.128	0.122	0.118	0.113
0.53	0.145	0.135	0.128	0.124	0.118	0.114	0.110
0.52	0.140	0.131	0.124	0.120	0.114	0.110	0.107
0.51	0.135	0.127	0.120	0.116	0.110	0.107	0.104
0.50	0.130	0.123	0.116	0.112	0.106	0.104	0.101

where A, B, C, D are values given in the following tables A, B, C, D.

Δ = displacement in tons,
V = speed in knots,
L = length in feet.

TABLE B—FRICTIONAL RESISTANCE. CORRECTION FOR RATIO $\frac{\text{BREADTH}}{\text{DRAFT}}$

$\frac{B}{d}$	Midship Section Coefficient			
	0.99	0.98	0.97	0.96
1.8	17.60	17.32	17.06	16.87
1.9	17.38	17.10	16.86	16.66
2.0	17.17	16.89	16.66	16.46
2.1	16.97	16.69	16.47	16.27
2.2	16 78	16.50	16.28	16.09
2.3	16.60	16.32	16.10	15.92
2.4	16.43	16.15	15.92	15.76
2.5	16.27	15.99	15.75	15.61

TABLE C—FRICTIONAL RESISTANCE. CORRECTION FOR LENGTH

Length	300 ft.	320 ft.	340 ft.	360 ft.	380 ft.	400 ft.
Coefficient	1.0410	1.0308	1.0217	1.0136	1.0064	1.0000
Length	400 ft.	420 ft.	440 ft.	460 ft.	480 ft.	500 ft.
Coefficient	1.0000	0.9943	0.9892	0.9846	0.9804	0.9765

TABLE D—RESIDUARY RESISTANCE. POUNDS PER TON OF DISPLACEMENT

$\frac{V}{\sqrt{L}}$	Prismatic Coefficient	Breadth ÷ Draft							
		1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5
0.64	0.82	1.26	1.31	1.36	1.41	1.46	1.51	1.56	1.61
	0.80	1.16	1.20	1.24	1.29	1.33	1.37	1.42	1.47
	0.78	1.07	1.12	1.16	1.20	1.24	1.28	1.32	1.36
	0.76	0.98	1.02	1.06	1.10	1.14	1.18	1.22	1.26
	0.74	0.91	0.94	0.97	1.00	1.04	1.08	1.12	1.16
	0.72	0.84	0.87	0.90	0.93	0.96	0.99	1.03	1.07
0.62	0.82	1.04	1.09	1.14	1.19	1.24	1.29	1.34	1.38
	0.80	0.97	1.01	1.05	1.09	1.13	1.18	1.23	1.28
	0.78	0.90	0.94	0.98	1.02	1.06	1.10	1.15	1.20
	0.76	0.84	0.87	0.90	0.94	0.98	1.02	1.06	1.10
	0.74	0.78	0.81	0.84	0.87	0.91	0.95	0.99	1.03
	0.72	0.72	0.75	0.78	0.81	0.84	0.87	0.90	0.93
0.60	0.82	0.90	0.94	0.98	1.02	1.07	1.12	1.17	1.23
	0.80	0.84	0.88	0.92	0.96	1.00	1.04	1.08	1.12
	0.78	0.78	0.82	0.86	0.90	0.94	0.98	1.02	1.06
	0.76	0.73	0.76	0.79	0.82	0.86	0.90	0.94	0.98
	0.74	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.90
	0.72	0.63	0.65	0.68	0.71	0.74	0.77	0.80	0.83
0.58	0.82	0.78	0.82	0.86	0.90	0.94	0.98	1.02	1.06
	0.80	0.73	0.76	0.79	0.83	0.87	0.91	0.95	0.99
	0.78	0.69	0.72	0.75	0.78	0.81	0.85	0.89	0.93
	0.76	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.86
	0.74	0.60	0.62	0.64	0.67	0.70	0.73	0.76	0.79
	0.72	0.55	0.57	0.59	0.62	0.65	0.68	0.71	0.74
0.56	0.82	0.66	0.69	0.72	0.76	0.80	0.84	0.88	0.92
	0.80	0.61	0.64	0.67	0.70	0.74	0.78	0.82	0.86
	0.78	0.57	0.60	0.63	0.66	0.69	0.72	0.76	0.80
	0.76	0.53	0.56	0.59	0.62	0.65	0.68	0.71	0.74
	0.74	0.50	0.52	0.54	0.57	0.60	0.63	0.66	0.69
	0.72	0.46	0.48	0.50	0.52	0.55	0.58	0.61	0.64
0.54	0.82	0.53	0.56	0 59	0.63	0.67	0.71	0.75	0.79
	0.80	0.50	0.53	0.56	0.59	0.62	0.66	0.70	0.74
	0.78	0.47	0.50	0.53	0.56	0.59	0.62	0.65	0.68
	0.76	0.44	0.46	0.48	0.51	0.54	0.57	0.60	0.63
	0.74	0.41	0.43	0.45	0.47	0.50	0.53	0.56	0.59
	0.72	0.39	0.41	0.43	0.45	0.47	0.49	0.51	0.54
0.52	0.82	0.44	0.47	0.50	0.53	0.56	0.59	0.63	0.67
	0.80	0.40	0.43	0.47	0.50	0.53	0.56	0.59	0.62
	0.78	0.38	0.40	0.43	0.46	0.49	0.52	0.55	0.58
	0.76	0.35	0.37	0.39	0.42	0.45	0.48	0.51	0.54
	0.74	0.32	0.34	0.36	0.38	0.40	0.43	0.46	0.49
	0.72	0.30	0.32	0.34	0.36	0.38	0.40	0.42	0.44
0.50	0.82	0.34	0.37	0.40	0.43	0.46	0.49	0.52	0.56
	0.80	0.31	0.34	0.37	0.40	0.43	0.46	0.49	0.52
	0.78	0.29	0.31	0.33	0.36	0.39	0.42	0.45	0.48
	0.76	0.27	0.29	0.31	0.33	0.35	0.38	0.41	0.44
	0.74	0.25	0.27	0.29	0.31	0.33	0.35	0.37	0.39
	0.72	0.22	0.24	0.26	0.28	0.31	0.32	0.34	0.36

Oil Burner for Scotch Boilers

THE Babcock and Wilcox Company, New York, has adapted its latest type mechanical oil burner, the "San Diego," designed for use on Babcock and Wilcox watertube boilers, for service in the furnaces of Scotch marine boilers.

This burner is built according to the same general design as all of the various types of burners produced by the Babcock and Wilcox Company. Its size and proportions, however, are made to conform to Scotch boiler burner conditions. The "San Diego" burner is hinged to the front plate of the furnace and the simple operation of breaking a single pipe

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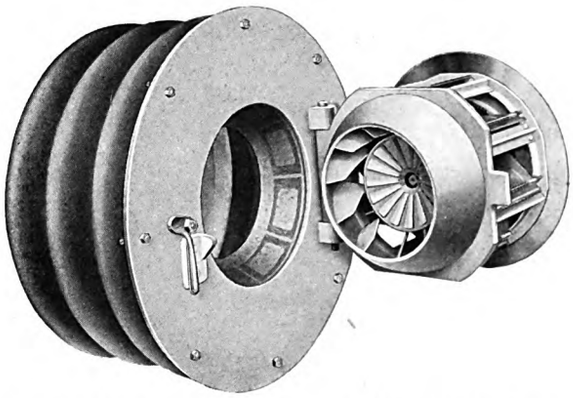
joint and dropping a latch enables the operator to swing out the entire burner and register whenever desired, thus providing free access to the furnace.

Several installations of this burner have already been made on Scotch boilers. The operating results reported indicate high efficiency, flexibility and ease of operation. On certain installations where "San Diego" burners have replaced other equipment fuel savings as high as 15 percent have been claimed, the oil burning without smoke and with low stack temperature.



"San Diego" Oil Burner Arranged for Installation on Scotch Boiler

Special Type Multiple Drill for Plates

THE accompanying illustration shows a special multiple drilling machine recently built by the Niles-Bement-Pond Company, 111 Broadway, New York, for the drilling, counterboring and tapping of steel plates.

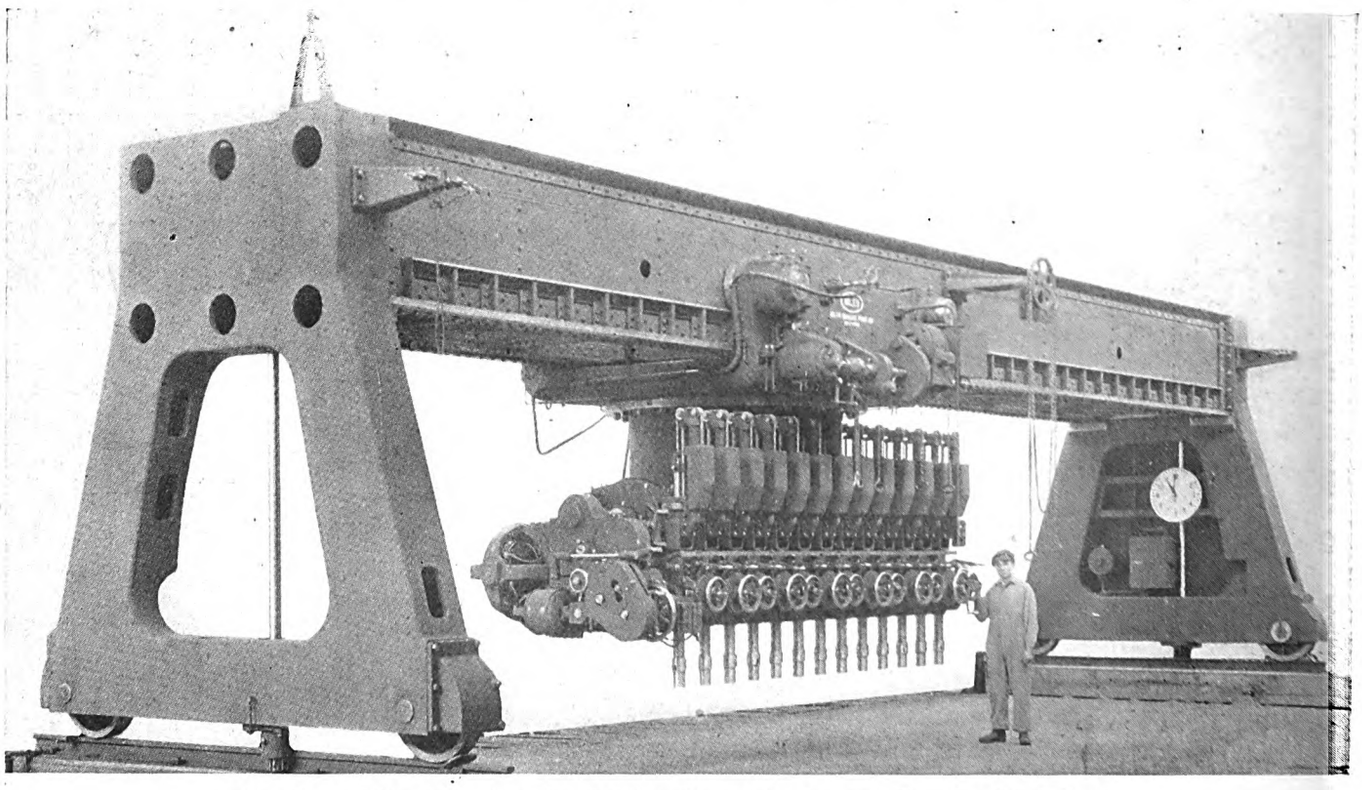
The machine is made up of two double-webbed steel plate girders supported 8 feet 10 inches above the floor by cast-iron housings placed 44 feet apart. A carriage on wheels, suspended as shown, is arranged to travel the length of the girders, and carries a cross-rail having 13 adjustable drill heads. The machine is mounted on wheels and travels on tracks on the shop floor, being driven by means of a 10 horsepower motor.

The spindles are driven by a 50 horsepower direct current motor mounted on the carriage. Spindle speeds from 120 to 360 revolutions per minute for drilling are provided and, by means of suitable gearing, speeds from 35 to 105 revolutions per minute for tapping. The spindles are 2 inches in diameter at the driving point and have No. 5 Morse sockets. They have a vertical adjustment of 13 inches. The center distances between consecutive spindles are 8 inches minimum, the maximum distance between the outside spindles being 12 feet 8 inches. Suitable spindle feeds are provided and each spindle has an independent feed clutch to permit disengaging one or more of the drills while the others are in operation.

The cross rail in which the 13 drill heads are mounted is pivoted on the carriage which permits swiveling a full revolution, a feature intended to enable the drilling of holes along the edges of plates, in any direction. A constant-speed reversible motor is provided for revolving the cross rail on the carriage and traveling the carriage on the girders, hand movement by ratchet being also provided for the cross rail and carriage.

Graduated scales for setting the drill heads are included and also adequate clamping facilities for the carriage and cross rail. All controls are placed in a position convenient for the operator.

J. T. EASON and F. F. Drysdale, who were formerly with the Supply and Sales Division of the Shipping Board and in charge of the immense stocks of shipbuilding equipment at Hog Island, have organized the Standard Steam Winch & Hoist Company, Perry Building, Philadelphia, Pa., and 100 Broadway, N. Y., which will deal in deck equipment.



Niles-Bement-Pond Machine for Drilling, Counterboring and Tapping Steel Plates

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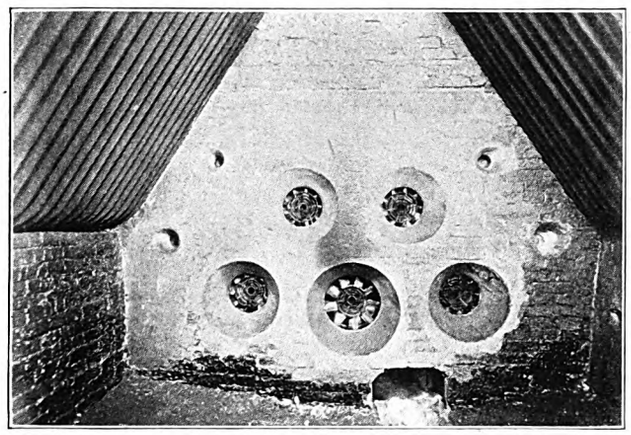
Long-Lived Burner Ring Refractory

IN the furnaces of oil-burning vessels trouble often develops at the burner ring. The flame here is so hot that it finds the cracks between laid-up fire brick. As a result, the bricks crack, crumble and, finally, drop out altogether. The boiler must then be taken off the line while furnace repairs are being made.

This trouble can be obviated, it is claimed, by the use of Plibrico furnace lining which is a refractory, plastic furnace lining that is applied in unbaked form by anyone who can

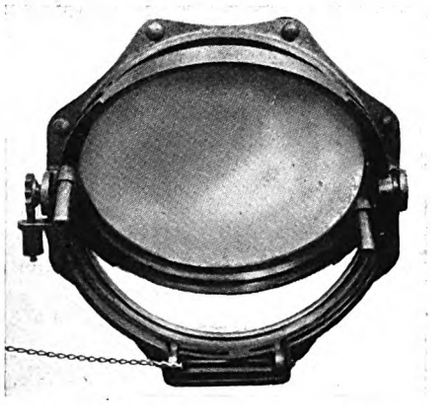


Plibrico Furnace Lining Applied to Burner Rings

use a mallet and trowel. When heat is applied it is vitrified and baked, to form a rock-like, airtight and gastight lining that is resistant to temperatures to 3,100 degrees F. The Jointless Fire Brick Company, 1130-1150 Clay Street, Chicago, Ill., manufacturers of Plibrico, say that when used in connection with burner rings on private and government owned ships, it has outlasted laid up fire brick two to four times.

Watertight Metallic Joint Features French Port Light

IN the new 75-S port light produced by the Sté. Anonyme des Ateliers et Chantiers de La Loire, Nantes, France, the principal feature is the elimination of rubber or metallic packing between the fixed frame and glass holder or dead light and holder in providing a watertight joint. The pressure on the joint is automatically limited to the exact point of watertightness. The basic principle of the port light is that of a cock plug working in its socket. The actuating mechanism of the device is similar to the breach of a field gun in a somewhat simplified form.



Watertight Port Light in Open Position

The 75-S port light may be supplied with an inside dead light fitted with a metallic joint or a non-watertight outside dead light or with both. The port light may be mounted so as to open either on the right or the left side. A safety device is also provided to prevent the inopportune opening of the port light.

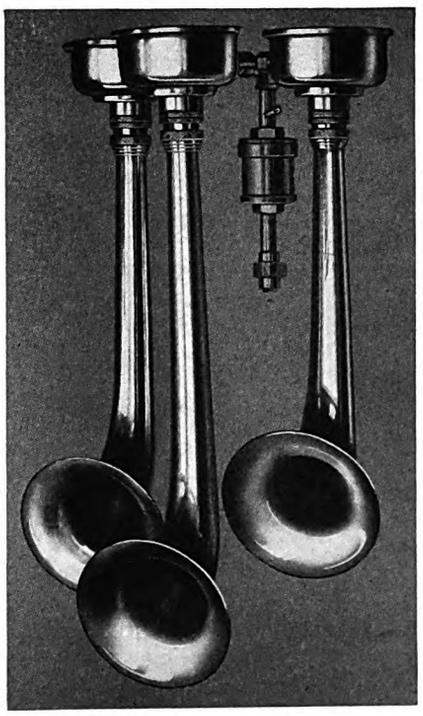
British Lifeboat Equipped with System of Manual Propulsion

A HAND propelling gear for lifeboats has been developed by I. R. Fleming and Company, Liverpool, England, which consists of a series of vertical levers connected at the lower ends to a fore-and-aft rod at either side of the boat under the thwarts. The fore-and-aft rods are in turn connected at the after end to connecting rods attached to crank disks fitted to a thwartship shaft; on this shaft, which is placed in the stern sheets, is a wheel geared to the propeller shaft. In connection with the thwartship shaft is a reversing gear. The boat is propelled by the passengers or members of the crew who move the vertical levers backwards and forwards thus setting the cranks in motion and thus the propeller shaft. The entire mechanism is encased but is readily accessible for inspection.

The Board of Trade has approved this type of propelling gear and when installed in a boat requires only 50 percent of the number of oars in the equipment.

High Power Marine Signals for Motor Craft

AN audible air-driven marine signal for yachts, cruisers, fishing vessels, motorships and the like is being produced by the American Strombos Company, Inc., Philadelphia, Pa. In the Strombos signal the production of sound is unlike that of any other device or instrument. The sound is produced by the emission through the agency of a specially designed air chamber and the valve action of the diaphragm of sharp individual blasts of air which, occurring with great frequency, set in longitudinal vibration the column of air in the projector; the resulting tone is of great power and penetrating quality.



Strombos Triplex Type Signal Installed on Motorship William Penn

The signal may be mounted in a horizontal or vertical position and connected to an existing air supply or to a thermo compressor system supplied by the company, which is fitted to the priming cup of one of the engine cylinders and compresses air in a steel reservoir. About 15 pounds air pressure is required to operate the horn but it will work on pressures up to 100 pounds.

The Strombos signal is operated by a lever or valve at the point of installation or by a remote electric push button controlling an electric valve.

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Questions and Answers Relating to Naval Architecture and Marine Engineering

Conducted by James L. Bates, Naval Architect, and W. B. Newton, Marine Engineer

This department is maintained for the purpose of answering all questions relating to ships and their machinery. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Rule for Estimating Amount of Fuel Oil in Double Bottom Tanks

Q. (1179).—Please give me a rule for estimating the amount of fuel oil in double bottom tanks according to the drag of the ship when you know the amount if ship had no drag. R. J. F.

A. (1179).—Let M be the fore and aft moment about the transverse axis through the sounding tube of the horizontal section of the tank.

Let L be the length between the draft gages or draft marks, whichever are used, for determining the trim of the vessel.

If M and L are expressed in foot units, then the following formula will give the increase or decrease in gallons due to one foot change in trim:

$$\frac{M}{L} \times 7.48$$

In using this formula it is customary to neglect the volume of the structure in the tank, as the error will be inappreciable considering the entire contents. On the above basis a curve is plotted for each tank showing the increase or decrease in capacity due to one foot change of trim of the vessel for the depth of oil read from the sounding tube. For the ordinary inner bottom tank this formula will give a constant correction for usual trims for varying depths of oil except as the tank becomes nearly full or nearly empty when the horizontal section of the tank (referred to above) cannot be used without modification in obtaining M.

How to Calculate Tank Capacities

Q. (1184).—Please inform me as to the best method of ascertaining the capacities of tanks, water or oil, on shipboard.

A. (1184).—The method at present followed by the United States Navy Department is to calculate tank capacities. The calculations are based upon the final plans of the vessels and may be made either by means of the usual rules of integration or by the aid of an integrator. These calculations are so worked out that the results may be plotted as capacity curves showing gallons and tons for feet depth of liquid. Allowance is made for obstructions.

Formerly tanks were calibrated by means of fresh water and standardized measuring tanks fitted with supply and outlet pipes with gate valves and outlets for hose. Every precaution was taken to avoid leaks, air pockets, sharp turns in leads, etc., to insure the tanks being completely filled and to allow for the effect of temperature variation. The results obtained were recorded in the form of curves as above described.

When there are a large number of tanks in a ship, as in the case of a modern capital ship, it is much less expensive and sufficiently accurate to calculate capacities as in the method first described.

Shrinking Cast Iron Couplings on Steel Shafts

Q. (1185).—Please give me all the information you can in reference to shrinking cast iron couplings on steel shafts. How much larger should the shaft be than the bore of the coupling? Will the same difference apply to large and small shafts? What amount of pressure will be required to draw the coupling, if properly shrunk on shafts of various sizes? What is a good rule for determining the sizes of keys to use? How would you secure a cast iron coupling on a bronze tail shaft?—Engineer.

A. (1185).—The allowance for shrinkage fits varies with the shape, distribution and thickness of the metal around the hole in the part to be shrunk on. This allowance is often the same as for forced fits. The choice as to whether a shrunk or forced fit should be used depends many times upon the size of the parts and the difficulty in handling them.

The following information is taken from Mark's Mechanical Engineers Handbook, page 687, from which the permissible allowances may be determined:

Maximum fibre stress in the hub (pounds per square inch) = 10,000 Kd, where d = allowance in inches per inch of diameter of hole, m = thickness of hub ÷ diameter of bore and K = constant having the following values:

For m =	0.0	0.1	0.2	0.3	0.4	0.5	1.0	1.5	2	∞
K (steel hub) =	2790	2400	2110	1900	1820	1750	1550	1480	1440	1390
K (cast iron hub) =	1400	1250	1150	1070	1030	1000	917	889	867	846

A good rule for a moderate forced fit such as is usually used for a coupling on its shaft is that the shaft shall be 0.0005 inch per inch of diameter larger than the coupling hole.

This rule applies to all diameters of shaft.

Tests have shown that the amount of pressure required to draw a shrinkage fit is about 3.66 times as great as for a forced fit for the same shaft diameters and same allowances as to fit. The pull necessary to withdraw a forced fit may be calculated from the formula

$$P = \frac{250 \times A \times a}{D^{1.05}}$$

In which A = circumferential area of the shaft within the coupling; a = total allowance in inches; D = diameter of the shaft within the coupling; P = load required in tons to withdraw the shaft regardless as to whether the coupling be of steel or cast iron.

The following rule for proportioning keys may be taken as good practice:

d = diameter of shaft.
b = breadth of key = $\frac{1}{4} d + \frac{1}{8}$ inch.
t = thickness of key = $\frac{1}{2} b$.
t_1 = depth of key way in hub = $0.3b$.
t_2 = depth of key way in shaft = $0.2b$.

A cast iron coupling should go on a bronze shaft with a moderate forced fit and be secured by one or more keys, the number depending upon the necessary key length required to keep within safe shearing and crushing stress. The keys should be so designed as to carry the entire turning load, no account being taken of the holding power of the forced fit.

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Calculations for Cooling Surface of Condenser

Q. (1192).—What is a good rule for determining the amount of cooling surface (surface condenser) for single, compound and triple expansion engines? How do you figure cooling surface of a surface condenser?

Q. (1192).—There are many things entering into the design of a surface condenser, chief among which are temperature of injection, vacuum desired, velocity of water through tubes and pounds of exhaust steam to be handled per hour, which complicate the problem to a point where a rule of thumb is too rough to be used for design purposes. The statement that a condenser contains a certain number of square feet of cooling surface means very little unless it is properly proportioned as to area through tubes per pass and length of tubes.

In order to explain the method used in proportioning a condenser, values will be assumed and an actual case worked out to fulfil certain given requirements.

W = total pounds of exhaust steam handled per hour = 93,000 (given).

$I.H.P.$ = indicated horsepower of engine = 6200 (given).

$S.H.P.$ = shaft horsepower deduced from I.H.P. = 6200 x 0.92 = 5,703.

R = pounds of exhaust steam per S.H.P. per hour = W ÷ S.H.P. = 93,000 ÷ 5703 = 16.31.

H_u = useful B.t.u. per pound of steam per hour = 2545 ÷ R = 2545 ÷ 16.31 = 156.

P = engine steam chest pressure in pounds absolute = 280 (given).

Q = quality of steam corresponding to P = 99.2 percent (assumed).

F = latent heat of steam at pressure P = 817.1 B.t.u. (from Steam Tables).

h = heat of the liquid corresponding to P = 386 B.t.u. (from Steam Tables).

H = heat contents of steam at pressure P and quality

$$Q = \frac{F \times Q}{100} + h = \frac{817.1 \times 99.2}{100} + 386 = 1196 \text{ B.t.u.}$$

H_s = heat contents of steam at vacuum in B.t.u. per pound = H — H_u = 1196 — 156 = 1040.

t_o = temperature of injection water = 60° F. (given)

P_s = desired vacuum in inches of mercury = 28 (given)

t_s = temperature corresponding to P_s = 101° F. (from Steam Tables)

t_w = temperature of air pump discharge = 85° F. (assumed)

H_t = heat transferred to cooling water, B. t. u. per pound of steam per hour = H_s — (t_w — 32) = 1040 — (85 — 32) = 987.

t_h = temperature head or difference between temperature corresponding to vacuum and temperature of overboard discharge = 20° F. (assumed). This figure would decrease as the temperature of injection increased.

t_1 = temperature of overboard discharge = t_s — t_h = 101° — 20° = 81° F.

t_r = temperature rise of cooling water = t_1 — t_o = 81 — 60 = 21° F.

L = pounds of cooling water required per pound of steam per hour = H_t ÷ t_r = 987 ÷ 21 = 47.

L_t = total pounds of cooling water per hour = W × L = 93,000 × 47 = 4,371,000.

Tubes to be ⅝-inch outside diameter and No. 16 B. W. G. thick.

A^1 = area through each tube in square inches = 0.192.

t_m = mean temperature difference between water and steam =

$$t_r \div \log e \frac{t_s - t_o}{t_s - t_1} = 21 \div \log e \frac{101 - 60}{101 - 81} = 29.26$$

S^1 = cooling surface per foot of length of the tube in square feet = 0.1636.

n = number of water passes = 2 (assumed)

V = velocity of cooling water through tubes in feet per second = 6 (assumed). This value varies anywhere from 2 to 7 feet per second depending upon the type of vessel in which the condenser is to be installed, and the duty of the condenser.

K_o = heat transferred per square foot per hour per degree mean temperature difference = 525 B. t. u. This value varies with the velocity of the water through the tubes and the mean temperature difference between the water and steam; and has been derived from performance of condensers in service.

S = total cooling surface in square feet =

$$\frac{W \times H_t}{K_o \times t_m} = \frac{93{,}000 \times 987}{525 \times 29.26} = 5{,}975.$$

A = area through each pass in square feet =

$$\frac{L_t}{230{,}400 \times V} = \frac{4{,}371{,}000}{230{,}400 \times 6} = 3.161.$$

N = total number of tubes =

$$\frac{A \times 144 \times n}{A^1} = \frac{3.161 \times 144 \times 2}{0.192} = 4{,}740.$$

Z = distance between tube sheets, feet =

$$\frac{S}{N \times S^1} = \frac{5{,}975}{4{,}740 \times 0.1636} = 7.70$$

NEW BOOKS

THE SHIPPING TRADES INDEX. Size, 9½ by 12 inches. Pages, 479. New York, 1922: Anglo American Publishing Company.

This directory of the various trades and lines of industry connected with shipping, including shipowners, shipbuilders and repairers, coal exporters, bunkering contractors, exporters and importers, marine insurance companies, etc., has been published annually in England since 1890.

The book is designed to be a complete directory of the shipping interests of the world but so far it can only be said to have achieved that object for Great Britain. This is the first year that a section has been devoted to America and, while considerable progress has been made, those looking for a complete index in this book of firms in this country connected with the shipping industry will be disappointed. A fair idea of the proportion of American firms listed may be obtained by the fact that 407 pages are devoted to Great Britain and only 73 pages to America.

OBITUARY

DR. S. TERANO, president of the Japanese Society of Naval Architects, died at Tokio, Japan, on January 8. Dr. Terano was a professor in the Engineering College of the Imperial University of Tokio and chairman of the Board of Directors of the Imperial Japanese Corporation.

BENJAMIN FRANKLIN CRESSON, JR., chief engineer of the Port of New York Authority, died in Montclair, N. J., on January 25 after an operation for appendicitis. Mr. Cresson was educated at Lehigh University and at the University of Pennsylvania. He was Deputy Commissioner for Docks in New York from 1909 until 1913, in which year he resigned to become engineer for the New Jersey commission investigating pier line extensions and port conditions. From April, 1914, to April, 1915, he was chief engineer of the New Jersey Harbor Commission. In April, 1916, he was appointed an associate member of the Naval Consulting Board. From 1917 to 1921 he was a member of the board of experts on terminal construction for the New York State Barge Canal; in 1918 he was consulting engineer to the War Board, Port of New York; from April, 1921, until his death, he was chief engineer of the Port of New York Authority and chairman of the Technical Advisory Board.

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Colonel John O'Neill Awarded Distinguished Service Medal of Congress

JOHN O'NEILL, assistant general superintendent at the International Mercantile Marine Company's Chelsea piers at New York, has received the Distinguished Service Medal of Congress, awarded for services rendered in the debarkation of troops at New York and the port of Brest during and following the war, at which time he was attached to the engineers, having been mustered out with the rank of lieutenant colonel. The presentation was made at 10 a. m., January 20, at the Officers' Club, Pier 60, North River, by Brig. General George H. Harries, O.R.C., under

Colonel John O'Neill Receiving the Distinguished Service Medal of Congress

whom Colonel O'Neill served. Colonel O'Neill has also received the red ribbon of the Legion of Honor of France. He holds several medals for life saving, both at New York and at Boston, where he formerly worked. On several occasions he has jumped overboard in winter to save a drowning man. His first rescue was in 1904, when he saved a man who had fallen into Boston harbor from the White Star liner *Romanic*. In 1907 he led a rescue party into the forecastle of the steamship *Anglican* when the vessel was filled with fumes from burning sulphur, and assisted in the rescue of several men. In March, 1910, he jumped from the steamship *Megantic* at midnight and held up a drowning man 35 minutes in icy water until help came. In February, man 35 minutes in icy water until help came. In February, 1916, he was three quarters of an hour in freezing water steamship *Colonian*. Mr. O'Neill began life as a stevedore at Liverpool, for the Dominion Line. He enlisted in the army in 1917, and after embarkation work at Newport News was sent overseas in October in the army transport service with the rank of captain. He assisted in the debarkation of 882,000 soldiers in France, and between the armistice and November 23, 1919, helped embark 1,102,000 men for home. He was mustered out December 22, 1919.

PERSONAL MENTION

H. G. SMITH has been appointed vice-president of the Bethlehem Shipbuilding Corporation, Ltd., in charge of sales with offices at 25 Broadway, New York.

ALFRED GILBERT SMITH, president of the New York and Cuba Mail Steamship Company, has received the nomination for president of the American Steamship Owners' Association. Mr. Smith has been actively engaged in ocean shipping all his life. In 1883 he entered the service of James E. Ward and Company, agents of the New York and Cuba Mail Steamship Company, and served through all the departments. In 1907 he was elected vice-president, general manager and a director of the New York and Cuba Mail Steamship Company and was appointed a member of the executive committee of the board of directors in 1916. Three years later he was elected president of the company to succeed Henry R. Mallory. Mr. Smith is a director of the Atlantic, Gulf and West Indies Steamship Lines, the Clyde Steamship Company, the Mallory Steamship Company, the New York and Porto Rico Steamship Company and the International Shipping Corporation.

A. G. Smith

EDWARD T. FISHWICK has been appointed vice-president in charge of sales, and general sales manager of the Worthington Pump & Machinery Corporation, 115 Broadway, New York.

G. T. BRADLEY, formerly traffic manager of the United States Shipping Board Emergency Fleet Corporation at Baltimore, has been transferred to New York as assistant head of the European and Mediterranean Trades Division.

DONALD F. WASHBURN, former assistant head of the European Trades Division in the Washington office of the United States Shipping Board Emergency Fleet Corporation, has been transferred to Baltimore as traffic manager of the Board.

P. SINCLAIR, assistant to the director of finance, United States Shipping Board Emergency Fleet Corporation, has resigned from this position, his resignation to take effect at the close of the present fiscal year. Mr. Sinclair joined the Emergency Fleet Corporation in April, 1922, and has had charge of the comptroller's department since that time.

D. A. BURKE, at present district comptroller of the United States Shipping Board Emergency Fleet Corporation at Philadelphia, will succeed P. Sinclair, assistant to the director of finance of the United States Shipping Board, Washington, D. C., whose resignation has just been announced. Mr. Burke will immediately be associated with Mr. Sinclair in the management of the comptroller's department, assuming complete control when Mr. Sinclair's services with the Board will have been completed at the end of the fiscal year.

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Shipbuilding, Reconditioning and Operation

Port Expansion, Passenger and Freight Activities and Other Notes of Interest in All Branches of the Marine Industry

Year's Activities Under Way

THE autumn of 1924 will see the Clyde Steamship Line equipped with two new ships for New York and Florida service, according to a statement made by H. H. Raymond, who was a guest of honor at a recent session of the Civitan Club in the Seminole Hotel, Jacksonville, Fla. Mr. Raymond, who was called on for a talk, announced that a naval architect is now making the specifications and that those and the plans will be submitted to the company in April of this year, and that these two ships will be ready for the direct from New York to Jacksonville service in the fall of 1924.

The North Atlantic & Western Steamship Company, commonly known as the Nawsco Line, and engaged in coastwise service between the Atlantic and Pacific Coast ports of the United States, looks forward with confidence to a record-breaking year as far as domestic business in the United States is concerned. The company is gradually putting itself in shape to be able to buy tonnage, presumably from the Emergency Fleet Corporation, with the ultimate purpose of converting such vessels from steam to Diesel propulsion. It is through the medium of internal combustion engines that the company hopes to reduce its operating expenses.

The United States Engineer Office, Galveston, Tex., which at present maintains and operates one seagoing hopper dredge and six hydraulic pipe line dredges, three derrick barges, one steam seagoing tug and about twenty smaller internal combustion drive tugs and launches, with three large barges working by contract, has an unexpended balance available for 1923 of approximately $2,275,000. For the replacement of wornout pumps the office will probably purchase during the year two 20-inch sand pumps. About $250,000 per month is being expended mostly for dredging operations.

The Engineer Office, for the First District, New York City, is understood to be considering the possibility of converting one or two dredges from coal to oil burning during this year, while the office at Jacksonville, Fla., is planning to construct three steel barges, each 80 feet by 26 feet by 5 feet for use of the dredge *Mallery*.

Newport News Co. Low Bidder For Four Dump Scows

WITH a price of $190,000 and a time figure of 45 days, the Newport News Shipbuilding & Dry Dock Company, of Newport News, Va., submitted the lowest tender for the construction and delivery of four steel dump scows complete, at the opening of bids at noon, on January 15, by Colonel Earl I. Brown, Corps of Engineers, U. S. Army, at Philadelphia, Pa.

The boats are to have an overall length of 144 feet, width overall 37 feet, depth of deck to inside 11 feet 8 inches, and are to be of the 7-pocket bottom dump type, each of about 850 cubic yards total capacity. Nine companies bid for the work.

West Palm Beach to Vote on $250,000 Terminal Issue

THE City of West Palm Beach, Fla., is about to vote on bonds for the purchase and improvements of terminal docks and other accessories and a cross state railroad. The amount of the issue will be $250,000 and the chances are strong that it will carry. The date of the election is February 13.

Ten Ships Under Order Abroad for the Eastern Steamship Company, of Canada; Also Five Canadian Lakers

TEN vessels are being placed to the order of Mr. A. B. Mackay, according to information received by MARINE ENGINEERING AND SHIPPING AGE, for the Eastern Steamship Company, of Canada, as follows:

Two vessels from J. S. White & Company, East Cowes.

Two vessels from Furness Steamship Company, Haverton Hill.

Two vessels from Napier & Miller, Old Kilpatrick.

Two vessels from Earles Shipbuilding Company, Hull.

One vessel from Cammel Laird & Company, Birkenhead.

One vessel from J. I. Thornycroft & Company, Southampton.

It is understood that the order for these vessels were negotiated for through a firm of shipbrokers, Messrs. Vogt & Maguire, in Liverpool.

This order has been placed by Messrs, H. E. Moss & Company, Liverpool, shipbrokers, who have, it is understood, also placed contracts for two steamers of a similar description with other builders on the North East Coast.

Quarter Million Dollar Contract for Two Tugs Awarded Tebo Plant; Will Be of Steel and Oil Burning

THE Tebo Yacht & Basin Company, of the Todd Shipyards Corporation, has been awarded a contract for the construction of two steel oil burning tugboats for the Standard Transportation Company, 26 Broadway, New York. Deliveries are scheduled for June and July. It is understood that the total cost will be close to $225,000.

Each vessel will have a length overall of 105 feet 9 inches, breadth molded 24 feet, depth molded 12 feet 9 inches. Propulsion will be by reciprocating engines developing about 800 horsepower.

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Two Diesel Lightships Planned

THE construction of two light vessels propelled by Diesel engines and equipped throughout with electrically driven auxiliaries, is the latest project contemplated by the Bureau of Lighthouses, of the Department of Commerce, Washington, D. C.

According to information obtained by MARINE ENGINEERING AND SHIPPING AGE, the desire to build a light vessel capable of remaining on station for one whole year without re-fueling at sea led the Bureau to the consideration of fuel oil burning instead of coal. Its investigations developed the following advantages for fuel oil: (1) less bunker space required; (2) smaller fireroom force; (3) less corrosion to ship in bunkers; (4) more flexible in maintaining low head of steam; with the following disadvantages: (1) bunkers more expensive to build; (2) dangers of leaks due to working of ship in exposed stations necessitating extreme precautions in designing connections and fastening, riveting, calking, etc.; (3) more machinery in boiler room to maintain, necessitating duplicate installation; (4) necessity of educating present personnel to new type of firing.

After consideration, it was decided to build *Light Vessel 105* adapted for oil burning. *Light Vessels 106-110*, later contracted for, were made oil burning based largely on the performance of *Light Vessel 105*. Diesel engines were then considered for this service and after investigation as to flexibility of control and economy in operation and having overcome the disadvantages of carrying fuel oil in bulk, the construction of two new Diesel drive ships, *Light Vessels 111* and *112*, equipped complete with electric auxiliaries, is planned.

Three and a Quarter Millions Required to Meet Vessel Needs of U. S. Lighthouse Service

THE increasing need of additions to the vessels of the Lighthouse Service, involving an expenditure of approximately $3,260,000 during the next three years, is pointed out in the annual report of G. R. Putnam, Commissioner of Lighthouses, to the Secretary of Commerce. In referring to the light vessel situation, new construction and reconditioning needs, etc., the Commissioner states:

NEED FOR REPLACEMENT

The annual reports for 1919, 1920, and 1921 gave full statements of the urgent need for the construction of additional vessels for the Lighthouse Service to replace those worn out in service, those lost through various casualties, and to meet the considerable growth of the service. The duty of the two types of vessels, tenders for buoy work and supply purposes, and light vessels for floating lighthouses, was explained, as well as the severe usage and hazardous service to which these vessels are exposed.

These conditions have been alleviated for the present with regard to large seagoing tenders by the transfer to this service from the War Department of six large mine-planting vessels.

The need for new light vessels is increasing. There are no vessels in other departments or the Shipping Board available for transfer which are suitable for use as light vessels, due to their special design and construction requirements. To maintain the serviceability of the light vessels, it is necessary to construct an average of two each year. Since 1910, and particularly since the beginning of war conditions, there has been a considerable deficiency in the building of vessels sufficient to keep up this program.

Of the light vessels now in use, 22 are more than 30 years old, and 11 are over 50 years old. Many of the lightships are not in condition to be safely placed on exposed stations. The cost of repairs and overhaul becomes so heavy that it is not economical to keep in commission vessels after they have reached a reasonable limit of usefulness. The effect of continuing the use of these old vessels is often a greatly diminished output of work with the same or greater cost of operation and upkeep. Of more importance than the question of efficient and economical operation, however, is that of safeguarding life. Both lighthouse tenders and lightships are engaged on hazardous duty, and their officers and crews should not be required to serve on vessels which have passed a reasonable limit of usefulness, nor can the Lighthouse Service properly perform its part in the safeguarding of life and property on the navigable waters of this country without necessary vessel equipment.

Congress, by the act of June 5, 1920, after full hearings, authorized a building program for vessels for the Lighthouse Service of $5,000,000, and an appropriation of $1,000,000 of this amount was made in the act of March 4, 1921. Under this and previous appropriations the following vessels are now under construction: Light vessels to replace *No. 20*, Cross Rip, Mass., *No. 3*, Handkerchief, Mass., *No. 11*, Scotland, N. J., *No. 34*, Charleston, S. C., and *No. 43*, relief, eighth district; tender to replace *Goldenrod*, fourteenth district. On the last contract much lower bids were received than for a number of years, and this appears to be a favorable time for vessel construction. No further vessels can be built, however, under available appropriations. During the fiscal year three tenders and four light vessels which had been condemned as unfit for further service were sold, the very small prices obtained indicating their extremely worn-out and unserviceable condition.

From careful estimates and examinations as to the condition and further serviceability of vessels of the Lighthouse Service it is found that, in addition to those provided for by vessels now building, 14 light vessels and 5 tenders should be replaced within the next five years. As it will require from two to three years after appropriation is made before vessels are available for service, funds should be provided now for 8 of these vessels, being those more urgently needed, and first named in the following list:

ADDITIONAL VESSELS FOR WHICH APPROPRIATION IS NOW NECESSARY OR SHOULD BE AVAILABLE WITHIN THE NEXT THREE YEARS.

Light vessel to replace No. 4, relief, second district, second class	$200,000
Light vessel to replace No. 70, San Francisco, Calif., second class	200,000
Tender to replace *Oleander*, fifteenth district, river class (special)	150,000
Light vessel to replace No. 57, Grays Reef, Mich., third class	150,000
Light vessel to replace No. 56, North Manitou Shoal, Mich., third class	150,000
Light vessel to replace No. 51, relief, third district, second class completion of vessel)	90,000
Recondition mine planter to replace *Lilac*, ninth district	35,000
Recondition mine planter to replace *Madrono*, eighteenth district	35,000
Light vessel to replace No. 5, Stone Horse Shoal, Mass., second class	200,000
Light vessel to replace No. 68, Fire Island, N. Y., second class	200,000
Light vessel to replace No. 69, Overfalls, Del., second class	200,000
Tender to replace *Holly*, fifth district, class B	300,000
Tender to replace *Arbutus*, fifth district, class B	300,000
Tender to replace *Daisy*, third district, class C	100,000
Light vessel to replace No. 48, Cornfield Point, Conn., second class	200,000
Light vessel to replace No. 1, Martins Industry, S. C., second class	200,000
Light vessel to replace No. 60, Eleven Foot Shoal, Mich., third class	200,000
Light vessel for Barnegat, N. J., second class	200,000
Light vessel for Grays Harbor, Wash., second class	150,000

Examinations For Draftsmen

THE United States Civil Service Commission announces an open competitive examination for ship draftsmen, Grade A (small boats). Vacancies in the Bureau of Construction and Repair, Navy Department, Washington, D. C., at $6.80 to $8.80 per diem, plus bonus. Appointees at annual compensation of $2,500 or less, whose services are satisfactory, may be allowed the increase granted by Congress of $20 a month.

Applicants should at once apply for Form 1312, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C.; the Secretary of the United States Civil Service Board, Customhouse, Boston, Mass., New York, N. Y., New Orleans, La., and postoffices in the principal cities.

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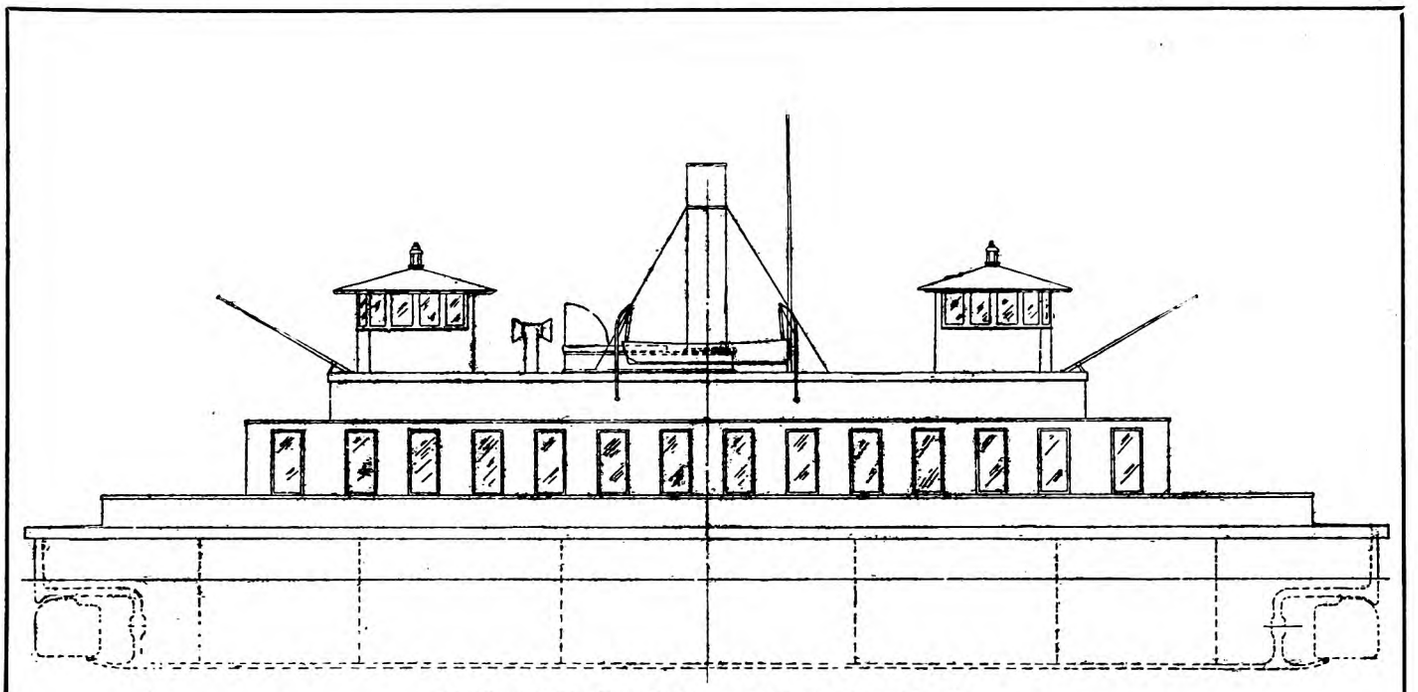

Outboard Profile of Proposed East River Ferries

Plans and Specifications for Eight Ferries to Cost $1,475,000 Submitted to Estimate Board

Vessels Are to Be Built of Steel Having a Length of 130 Feet Driven by Twin Screws—Specifications Provide for Steam Engines With Alternate Bids for Diesel Installations

PLANS and specifications for the construction of a total of eight ferryboats for New York City, to be built at a total cost of $1,475,000, have been submitted by Grover A. Whalen, Commissioner of Plant and Structures, to the Board of Estimate and Apportionment, with a request for the authorization of funds. The commissioner requests five new boats to cost about $925,000, for the Grand Street-Broadway Municipal Ferry Line and for the Union Ferry Lines, which were taken over by the city on December 17, last, and three boats to cost about $550,000, for the East 92nd Street-Astoria and Clason Point-College Point Ferry Lines.

For these various East River Lines the commissioner plans an all steel boat, having a length over guard of 130 feet, beam over guards 52 feet, draft 8 feet 6 inches, driven by screw propellers instead of side wheels, with three gangways for vehicles and two cabins, all on one deck. The boats are planned to be driven by high pressure two-cylinder steam engines, but alternate bids will be received for equipment with either double compound steam engines or Diesel engines, direct connected. In the case of the steam installations, oil will be used for fuel instead of coal, the boats being designed to make a speed of 10 miles an hour instead of 5 or 6.

Commissioner Whalen stated that the boats can be operated much more economically than the present ferries, saving not only in repairs and maintenance but in actual operating costs.

Contract Awarded Hildebrand Yard, Kingston, for Construction of Two More Diesel Towboats

THE contract for the construction of two Diesel towboats for the Transmarine Corporation, of 11 Pine Street, New York City, has been awarded the Hildebrand Shipyard, at Kingston, New York. The boats were designed by R. R. Livingston, naval architect and marine engineer, 2 Rector Street, New York, and are duplicates of three boats recently completed by the same shipyard and which were also designed by Mr. Livingston. It is understood that the contract will involve approximately $75,000.

The boats will have an overall length of 63 feet, beam 14 feet, draft 7 feet, the propelling machinery of each boat consisting of a 6-cylinder 180 horsepower Nelsco Diesel engine.

Gasoline Ferry Rebuilding; New Boilers in Mate

THE gasoline ferry boat *Pelican* is undergoing a complete rebuilding at the South side dock of the Jacksonville Ferry and Land Company, with the view of placing the craft on the run now being taken care of by the steam ferry *Duval*. The change will only be temporary, states J. N. Cook, manager of the company, the *Pelican* to run while the *Duval* is having new boilers installed.

The deck of the *Pelican* will be renewed, two new cabins built, and a runway for automobiles enlarged.

Ward Works Low For Constructing Dredge Wautaga

THE Charles Ward Engineering Works, Charleston, W. Va., was low bidder for the construction of a 2-cubic yard steel dipper dredge, to take the place of the dredge *Wautaga*, at the opening of bids by United States Engineer Office, Nashville, Tenn., on January 16. The company's price was $60,574.

The proposed boat is to have an overall length of 108 feet.

New Bulkhead

COMMISSIONER of Docks, Pier A, foot of Battery Place, North River, Manhattan, received sealed bids at 12 o'clock, noon, on Monday, January 22, for the construction of a concrete bulkhead wall along the Harlem River Driveway, between 165th and 193rd Streets. The contract will cost close to $200,000.

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Marine Construction News of the Month

Ship Contracts — New Ship Concerns and Shipyard Improvements—Terminal Projects—Government Contracts

SHIPS AND SHIPBUILDING

Repair Work, Baltimore, Md.—H. E. Crook Company has been awarded the contract for repair work on the steamer Dallas.

Docked and Overhauled, Mare Island, Cal.—The navy tug Vigilant was taken to the Mare Island Navy Yard for docking and overhauling.

Miscellaneous Repairs, Chester, Pa.—The Shipping Board steamship Chickamauga has been awarded to the Sun Shipbuilding Company for miscellaneous repairs.

Steamship Drydocked, Chester, Pa.—The Shipping Board steamship Bannock was awarded to the Sun Shipyard for drydocking and miscellaneous repairs.

Steamer Purchased, New York.—Steamship Canibas, 9,947 deadweight tons, was bought at auction by the Matson Navigation Company for $198,100.

General Repairs, Floreffe, Pa.—The steamer Vulcan of the Vesta Coal Company was placed on the marine ways of the company at Floreffe for general repairs.

Japanese to Convert Liners.—All the Nippon Yusen Kaisha liners operating between Yokahama and the Atlantic seaboard of America are to be converted into oil burners.

Collision Damage Repairs, Brooklyn, N. Y.—The Morse Dry Dock & Repair Company was awarded the contract to repair collision damage on the steamship Mexico. Price about $22,000.

Steamers Sold, New York.—The Shipping Board has sold the ex-Atlantic-Gulf and Pacific steamers Henry S. Grove and Charles H. Cramp to the Argonaut Steamship Corporation of New York.

Tanker Drydocked, New Orleans, La.—The Mexican Petroleum Corporation's tanker Crampton Anderson was placed on the docks of the Jahnke Dry Dock Company for overhauling and repainting.

Contracts Awarded, Philadelphia, Pa.—Cramp Ship and Engine Building Company was awarded the contracts for work on the British tanker Cheyenne and the American schooner Esther K.

Contract Award, New York.—The New York Harbor Dry Dock Company was awarded a contract for repairs to the steamship West Calumb, for which bids were opened on December 21. The price was $1,278.

Minor Repairs, West Coast.—The Pacific Coast Engineering Works was awarded the contract for replacing the main steam pipe and other minor repairs to the engines of the steamship Bessie Dollar.

Steamer Allocated, New York.—The Shipping Board has allocated to the Cosmopolitan Line the 8,550 deadweight ton steamer Cohasset, for service from New York and Philadelphia to French Atlantic ports.

Repairs and Drydocking, Philadelphia, Pa.—The Pennsylvania State Nautical Schoolship Annapolis has been taken to the League Island Navy Yard for minor repairs and drydocking preparatory to the winter cruise.

Car Float Launched, Camden, N. J.—A car float 340 feet long, built for the Brooklyn Eastern District Terminal Company, was launched at the yards of the New York Shipbuilding Corporation, Camden, N. J.

Repairs, Brooklyn, N. Y.—The Robins plant of the Todd Shipyards Corporation has been awarded the work of repairing the tank steamer Alabama, which recently went aground off the Mexican coast, at a cost of $77,000.

Steamship Purchased, New York.—The Garland Steamship Line has purchased the steamship West Cavanal, of 8,564 deadweight tons, 410 feet long with a 54-foot beam. Price $171,000. She will be generally overhauled.

Aero Alarm Contracts.—The Seattle office of the Aero Alarm Company has contracts for the extension of the Aero Alarm System on the steamships President Jackson and President Grant, of the United States Shipping Board.

Repairs to British Steamship, Brooklyn, N. Y.—With a bid of $66,000, the Morse Drydock and Repair Company has been awarded a contract for repairs to the British steamship Cairndhu, which grounded in the St. Lawrence River.

Schooners Docked, Baltimore, Md.—Schooners Charles G. Gawthrop and W. H. Woodin, purchased by the Maryland Navigation Company from the American Car and Foundry Company, were taken to Baltimore to be fitted out for service.

Steamship Drydocked, Sparrows Point, Md.—Steamer City of Flint, of the Exportation Transportation fleet, was placed on the docks of the Sparrows Point plant of the Bethlehem Shipbuilding Corporation preparatory to loading for Europe.

Two Tugs Sold.—The Shipping Board has sold the 418 gross ton steel ocean type tug Barren Fork to S. A. Guilds, of Charleston, S. C., and the similar type and tonnage tug, Butterfield, to the Newaygo Tug Line, Inc., of Wisconsin Rapids, Wis.

Transport Purchased.—The Robert Dollar Company has purchased the former army transport Dix. This vessel, having served for more than twenty-five years on the Pacific, is expected to be used in the trans-Pacific trade. Price, approximately $25,000.

Steamer Allocated, Mobile, Ala.—The steamer Westland, of 6,800 deadweight tons, has been allocated by the Shipping Board to the Waterman Steamship Company, of Mobile, Ala., for its Mobile-Liverpool and West Coast United Kingdom ports' service.

Steamers Repaired, San Pedro, Cal.—Steamers El Cicuta, El Abeto and El Cedaro, recently purchased by the Los Angeles Lumber Products Company, were awarded to the Los Angeles Shipbuilding & Dry Dock Corporation yards to be converted to oil burners.

Steamship Purchased, West Coast.—The Alaska Steamship Company has purchased the Shipping Board steamship Delrosa for service between Seattle and Alaskan ports. The vessel can carry 5,000 tons of cargo, is 321 feet long, 46 feet beam and 24.4 feet in depth.

Vessels Drydocked, San Francisco, Cal.—The Bethlehem plant was awarded the following contracts: Asbury Park, drydocked for cleaning and painting; the Yellowstone, cleaning and painting; W. S. Rheem, drydocking; Barge 95, of Standard Oil Company, for survey.

Successful Trials, Pa.—The new passenger and freight steamship Haleakala, built for the Inter-Island Steam Navigation Company of Honolulu by the Sun Shipbuilding Company, Chester, Pa., passed successful trials off the Delaware Capes, exceeding its contract speed of 17½ knots.

New Engines for Coaster, Oakland, Cal.—Two new thirty-five-ton Diesel engines are being installed in the steamer Frank Lynch of the Frank Lynch Lumber Company, of San Diego, by the Crowley shipyard crew at the plant of the Union Construction Company in Oakland.

Contract Awarded, Staten Island, N. Y.—The New York Harbor Dry Dock Company, low bidder with a price of $38,900, received the contract for alterations and installations on the 353-foot combination passenger and cargo steamer President Arthur, of the United States Shipping Board.

Shipyard Activities, Oakland, Cal.—The Hanlon Shipbuilding and Drydock Company has been awarded the contracts on the following: Lumber carrier Edna Christenson, new tail shaft; steam schooner Necanicum, schooner Resolute and bark Monongahela, general repairs and drydocking.

New Ships Ordered by Canada.—Thirteen steamers, averaging 250 to 300 feet long, have been ordered or are ready to be placed with British shipyards for use on the Great Lakes of Canada and the United States. These boats will be capable of carrying from 90,000 to 100,000 bushels of wheat.

Tankers Drydocked, Galveston, Tex.—The Shipping Board tankers Houma and West Erral were taken to Galveston to be drydocked for overhauling. The tied-up Shipping Board tankers at Orange, Texas, will gradually be withdrawn and brought to Galveston for repairs as the demand for tonnage increases, according to officials.

Sale of Two Lake Type Vessels.—The Shipping Board has sold the lake type steel cargo vessels Lake Gera, of 4,155 deadweight tons and 2,637 gross tons, to the Lone Star Steamship Company, of Galveston, Texas, and the similar type vessel, Lake Pepin, of 2,989 deadweight tons and 1,997 gross tons, to the Hammond Lumber Company, of San Francisco.

Fishing Steamers, Maryland.—A contract has been awarded to M. M. Davis & Son, shipbuilders at Salomons, Calvert County, Md., for the construction of two fishing steamers for fish-products factories at Reedville, Va. One of the vessels is to be 140 feet long, the other 135 feet, the larger of the two to be equipped with two 200-horsepower crude oil engines. Both are to be lighted by electricity.

Vessels Drydocked, West Coast.—The following vessels were reported drydocked: At the Moore Shipbuilding Company, steamers South Coast, Mount Baker, Carolyn Francis and tug Crolone; at the Crowley yards, steamers Admiral Schley, Jeptha, destroyer De Long, subchasers Vaughn and Cygon and barges Crowlet 9 and Napa; at the Bethlehem yard, steamers Vinita, West Jena, Grays Harbor and Acme.

Steamer Reconditioned, San Pedro, Cal.—The Los Angeles Shipbuilding and Dry Dock Corporation was awarded the contract to recondition the steamship Calawaii, formerly the United States Army transport Sherman, by the Los Angeles Steamship Company; the work to consist of complete overhauling, entire refitting and refurnishing of all passengers' quarters, and conversion to an oil burner. Estimated cost $300,000.

Stern Wheel Harbor Boat, Pittsburgh, Pa.—The Marietta Manufacturing Company has received a contract from the Jones & Laughlin Steel Company for the construction of an all-steel stern wheel harbor boat. This boat is to be 64 feet long on deck and 82 feet overall. The boat, which will be engaged in the Pittsburgh-Aliquippa trade after completion, will be of the scow prow type, equipped with a Fairbanks-Morse Diesel oil burning engine of 200-horsepower, with a solid drive shaft.

Steamers Allocated, New York.—The Shipping Board has allocated the 9,789 deadweight ton steamer Waukegan to the Cosmopolitan Shipping Company of New York, for their New York-Philadelphia-French Atlantic service; the steamer Cohasset, 8,500 deadweight tons, to the Black Diamond Steamship Corporation of New York, for their Philadelphia-New York-Antwerp general cargo service, and the steamer Abren, 7,814 deadweight tons, to the Export Steamship Corporation of New York for their New York-Levant general cargo service.

Vessels Awarded for Repairs, New Orleans, La.—The Jahncke Dry Docks, Inc., has been awarded the following contracts: Minor repairs to steamship West Segovia of the Shipping Board, damaged by

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fire, repairs consisting principally of replacing a bulged and buckled deck plate, restoring a little woodwork and renewing burned out electrical installations; steamship Blaafjeld, to undergo alterations and repairs; steamship Rajah, for overhauling; and the Tegucicalpa, Vaccaro Brothers Steamship, the barge Chargres and the Mississippi Warrior towboat Natchez, for repairs.

SHIPYARDS AND DRYDOCKS

Shipbuilding Plant Sold, Port Wentworth, Ga.—The plant of the Terry Shipbuilding Corporation, at Port Wentworth, has passed into the hands of the Georgia Wool Stock Company and the American Mills International Company, both of Atlanta, at a price of $506,000.

Shipyard to Be Dismantled, Bristol, Pa.—The yard of the Merchant Shipbuilding Company at Bristol, Pa., is to be discontinued and the ways there dismantled, as a result of concentration of all the shipbuilding activities of the Harriman interests at the single shipyard of William Cramp & Sons' Ship and Engine Building Company, at Philadelphia, according to announcement by R. H. M. Robinson, chairman of the executive committee of the company and president of the Merchant Shipbuilding Company, also a Harriman shipbuilding organization.

Facilities Enlarged, Los Angeles, Cal.—According to announcement by Charles M. Schwab, head of the Bethlehem Steel Corporation, following inspection at Los Angeles Harbor of the Bethlehem Shipyard and Dry Dock Corporation, a larger drydock than the present one now in use and increased shipbuilding facilities will be erected shortly at the Los Angeles yards. Vice-president E. B. Hill, of the Bethlehem concern, who accompanied Schwab on the inspection trip, indicated that the Bethlehem plant there would soon devote greater energy to the manufacturing of Diesel engines.

Crook Company Gets Repair Plant, Baltimore, Md.—The drydocking and repair facilities of the Union Shipbuilding Company have been taken over under a lease by H. E. Crook Company. These additional facilities will be operated in conjunction with the present yard of the Crook Company at Locust Point, Md., and will be used primarily for underwater work, enabling docking of vessels up to 420 feet in length and to handle heavy and light repair work and mechanical installations of every description. A Crandall 10,000 deadweight ton electric railway, along with the rest of the equipment, all entirely new, equips the company with one of the most complete plants of its kind on the Atlantic seaboard. The plant is equipped with three shipbuilding ways and is able to accommodate the largest class of vessels.

PORT IMPROVEMENTS

Grain Elevator, Ft. William, Ont.—Bole Grain Company, Ltd., plans concrete grain elevator. $500,000.

Grain Elevator, Corpus Christi, Tex.—F. Kell, Wichita Falls, plans concrete grain elevator, $250,000.

Dredge and Harbor Improvements, Aberdeen, Wash.—$250,000 has been voted for dredge and harbor improvements.

Grain Elevator, Montreal, Canada.—Montreal Harbor Commissioners plan 10,000,000 bushel grain elevator. Price $10,000,000. W. L. McDougald, president.

Wharf and Shed, New Orleans, La.—The Engineering Department, Board of Commissioners, 200 New Court Building, is having plans prepared for a reinforced concrete wharf and shed along Industrial Canal. $1,400,000.

Wharf Contract, New Orleans, La.—The contract for the reconstruction and rat-proofing of the Robin Street Wharf was let by the dock board to John Riess, New Orleans contractor, on a low bid of $196,000, work to be completed within 220 days.

Levee, New Orleans, La.—Orleans Levee Board, New Court House Building, has awarded a contract to H. Reynolds, Maison Blanche Building, for a new levee on the left bank of the Mississippi River. Price $26,801.

Grain Elevator, Owen Sound, Ont.—Owen Sound Elevator Company is having plans prepared for grain elevator, steel and cement, on waterfront. Price $150,000. R. Patterson, manager. Prices wanted on materials. Private plans.

Harbor Improvement, Midland, Pa.—The General Contracting Corporation received a contract to improve the harbor at the Crucible Steel Company's Midland plant on the Ohio River. About 30,000 cubic yards of material will be removed.

Traveling Crane, San Francisco, Cal.—The contract for furnishing and installing an electric traveling crane in Mocassin Creek Power Plant, Hetch Hetchy Project, was awarded to Pawling & Harneschfeger, 32 Beale street, by the City and County of San Francisco, at a price of $30,475.

Dock, Warehouse, Etc., New Orleans, La.—Board of Port Commissioners, Suite 200, New Court Building, has had surveys made for dock and warehouse at foot of St. Joseph street, $400,000; plans are being prepared for wharf apron, heavy timber construction, at foot of Barracks street, $30,000.

Wharf and Bulkhead, Weymouth (Boston P. O.), Mass.—Edison Electric Illuminating Company, of Boston, 70 State street, Boston, is having preliminary plans prepared for a wharf and bulkhead adjoining proposed power plant, Weymouth. Price $50,000. Stone & Webster, Inc., 147 Milk street, Boston, architects and engineers.

Two Piers, Virginia.—Two smaller piers will be added to the docking facilities at Old Point by the United States War Department for the accommodation of smaller river and harbor crafts, according to the announcement at the United States Army Engineers' office here. The wharf will be improved also in the project, the entire cost of which will total about $40,000.

Secretary Weeks has approved tentative plans for the new work, and specifications will be shortly announced. Bids for the job will then be asked of constructive companies.

GOVERNMENT WORK

Dredging, Norfolk, Va.—Specification 4771. Bureau of Yards & Docks, Navy Department, Washington, D. C., plans dredging in Norfolk Harbor.

Barges, Pittsburgh, Pa.—United States Engineer, Pittsburgh, awarded the contract for three steel deck barges to McWilliams Co., Inc., Exchange Building, Memphis, Tenn.; price $85,082.

Catamarans, Savannah, Ga.—United States Engineer Office awarded the contract for furnishing 25 pontoon catamarans for U. S. dredge Morgan, to Charles Ward Engineering Company, Charleston, West Virginia; price $22,375.

Dredging, Charleston, S. C.—The Seaboard Dredging Company, Durkee Building, Jacksonville, Fla., was awarded the contract for dredging the western channel and Sampit River, Winyah Bay, by the United States Engineer Office, Charleston. Price $99,594.

Dredging, Jacksonville, Fla.—The Clark Dredging Company, Miami, has been awarded the contract for dredging in Key West Harbor by the United States Engineer Office, Jacksonville; price $1.43 per cubic yard; 63,000 cubic yards of dredging.

NEW INCORPORATIONS

The Shamrock Towing Company, of New York, capital $200,000, chartered under Delaware laws.

Sagua Steamship Corporation, capital $35,000, of the Atlantic Fruit Company, incorporated at Delaware.

Sydney S. Brees, of Port Jefferson, to do business in boats and ships, has been incorporated for $50,000.

The Moore & McCormack Company, of Manhattan, has increased its capitalization from $5,000 to $500,000.

Tanamo Steamship Corporation, capital $35,000, of the Atlantic Fruit Company, incorporated at Delaware.

The United Steamship Corporation, of Wilmington, Del., capital $250,000, chartered under Delaware laws.

Connelly Transportation Company, of Buffalo, capital $350,000, chartered at Albany, to engage in navigation.

The Quincy Steamship Company, of Manhattan, capital $100,000, chartered at Albany. H. Goldman, of 120 Broadway, attorney.

The Nautilus Steamship Corporation, of Manhattan, capital $700,000. Incorporators are: F. V. Barnes, R. F. Wees and J. F. Fessenden.

Shamrock Towing Company, of Manhattan, capital $10,000, incorporated at Albany. Incorporators: D. J. Dugan, H. H. Lavender and J. J. McGuirl.

The Caddell Dry Dock Repair Company, of Richmond, Va., capital $250,000, incorporated at Albany, N. Y. Incorporators are: J. B., L. W. and A. Caddell.

The Brighton Dry Dock Company, of West New Brighton, S. I., capital $250,000, chartered at Albany. Incorporators: J. O. Connor, M. E. Saunders and A. W. Osborn.

The Safety Steamship Company, of Bridgeport, capital $100,000, to do transportation business. Incorporators are: Arthur Wilkes, Lawrence R. Ahern and David F. Blume.

Commercial Scout Steamship Corporation, capital $100,000, chartered at Dover, Del. Incorporators are: Linn P. Reed, James H. Tully, and Wallace Ingraham of New York.

American Indian Steamship Corporation, capital $2,000,000, chartered under Delaware laws, headquarters to be at Tulsa, Oklahoma. The board of directors of the corporation will include bankers, oil men and ranch owners of Oklahoma, all members of American Indian tribes.

FOREIGN ACTIVITIES

Two New Vessels, England.—Messrs. Sir Robert Ropner and Company, West Hartlepool, have placed orders with the Ropner Shipbuilding Company, Stockton, for two cargo boats of 8,500 and 7,700 tons, respectively.

Harbor Developments, Tolago Bay, New Zealand.—The Harbor Board of Tolago Bay, New Zealand, is considering the construction of a wharf and other facilities with sheds and a wool warehouse, estimated cost of the work being £70,000.

Harbor Improvements, Spain.—According to a report received by the Department of Commerce from Ambassador Woods, harbor construction and improvements in Spain are to be undertaken through an appropriation of 18,500,000 pesetas made by the Ministry of Public Works as a Government financial guarantee for loans to be secured by public subscription or otherwise.

Steamer Launched, England.—The twin-screw steamer Muritai, built for the Eastbourne Borough Council, Wellington, New Zealand, for passenger service in Wellington Harbor, has been launched by the Conster Construction Company, Montrose. The vessel is 172 feet 6 inches length overall, 30 feet beam, 12 feet 3 inches deep, and has a speed of 13 knots. Her carrying capacity is from 1,400 to 1,500.

Vessel Launched, Shanghai, China.—The Tze Sui, a vessel designed specially for service on the Upper Yangtse, was launched from the Shanghai yard of the Societe Franco-Chinois de Constructions Metalliques et Mechaniques, for Chinese owners. She is a twin-screw steamer, 140 feet long, has a loaded draft of 4 feet 6 inches and is provided with ample cargo space, as well as accommodation for a large number of passengers of three classes. She is equipped with two sets of triple expansion engines and has a contract speed of 14 knots.

Finnish Shipbuilding in 1922.—New constructional work at the Finnish shipbuilding yards experienced a further decline in 1922, according to the information collected by the statistical department of the Finnish State Shipping Administration. Vessels under construction amounted to 232 representing a total of 14,099 gross register tons, most of which were lighters. These figures compare with 289 vessels and 25,199 tons in 1921 and 159 and 31,935 tons, respectively, in 1920. Two of the ships under construction in 1922—one steamer and one sailing vessel—were not completed by the end of the year. The total included 20 steamers, 24 motorships and 11 sailing vessels.

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STEAMSHIP INTERESTS

The Norfolk, Baltimore, Carolina Line, Inc., will inaugurate, this month, a service to points in eastern North Carolina from Norfolk and Baltimore. One boat will be operated on one round trip a week (starting Tuesday and returning Thursday) between Norfolk and New Bern. A smaller vessel, to be used as a feeder, will be operated on three trips each week between New Bern and Morehead City and Beaufort.

According to W. B. Keene, Director of Traffic, United States Shipping Board Emergency Fleet Corporation, a telegraphic report has been received from Vancouver, B. C., to the effect that the Trans-Pacific Conference Lines in a meeting held recently unanimously adopted and signed the new Trans-Pacific Conference agreement. This agreement is along similar lines to that recently adopted in the North Atlantic under which the lines operating from the Atlantic Coast to the Far East are now functioning, which principally provides for the maintenance of certain rates.

The Red Star liner *Belgenland*, now nearing completion at Belfast, will make her first sailing from New York on April 14, operating with the Lapland in fortnightly service for first, second and third class traffic between New York, Plymouth, Cherbourg and Antwerp, which with the cabin-class service will maintain weekly sailings from New York, as at present.

The Red Star Line will, starting April 25 with the *Zeeland* from New York, open a cabin-class service between New York and Antwerp, with calls at Plymouth and Cherbourg eastward, and Southampton and Cherbourg westward on each voyage. The *St. Paul* is the other ship to be used. Each ship will carry in the new service one class of cabin passengers, and third class. The first sailing of the *St. Paul* will be from New York, May 9.

The *Orbita* and *Orduna*, of the Royal Mail Steam Packet Company, are to be converted to one cabin ships, and according to announcement, will in the future carry only cabin and third class passengers. As a result of the classification change there will be a pronounced reduction in the fares.

BUSINESS NOTE

Hanna Engineering Works, 1765 Elston avenue, Chicago, manufacturer and distributor of Hanna riveting machines, air hoists, sand sifters, Mumford molding machines and the Milwaukee Spruce Cutter, is now represented in Detroit and surrounding territory by the Charron Engineering Sales Company, 1002 Real Estate Exchange Building, Detroit, Mich.

TRADE PUBLICATIONS

CALENDARS FOR 1923.—An artistic calendar for the year 1923 has been sent out by the Morse Dry Dock and Repair Company, Brooklyn, N. Y. A feature of this calendar which will be greatly appreciated by shipping interests in the port of New York is a tabulation of high tides, the time of high water at Governor's Island for both A. M. and P. M. appearing in each date square for that day. The calendar is also illustrated with a photograph of the steamship *Resolute* in dry dock and the *Conte Rosso* backing into a dry dock at the Morse plant.

The Federal Shipbuilding Company, Kearny, N. J., has distributed a calendar on each sheet of which the present month is shown in red and the preceding and coming months in black, giving instant inspection of the current three months. The calendar pad includes each month from December, 1922, to January, 1926, and these pads may be renewed indefinitely as the body of the calendar is of enameled sheet metal.

CORROSION.—The subject of pipe corrosion is discussed in Bulletin No. 3-C issued by the National Tube Company, Pittsburgh, Pa. It is agreed by authorities that oxygen holds the dominating position together with the electrochemical theory in causing internal corrosion. An explanation of this action is given in the bulletin together with the details of the mechanism of corrosion in abstracts from papers which have been delivered before various professional societies. Practical means of preventing corrosion are outlined and the results which may be expected from various methods of water treatment and the like.

MOTORS AND GENERATORS.—Bulletins 126 and 127, covering direct current motors and generators and electric arc welding units, have been distributed by the Burke Electric Company, Erie, Pa. Detailed construction features of the motors and generators are described in Bulletin 126 while No. 127 illustrates the various types and capacities of welding equipment produced by the company.

STOP VALVES.—The R. S. V. stop valve and by-pass made by the R. S. V. Corporation, New York, and its functions are described in a catalogue recently sent out by this company. The device is a drier and superheater of steam for marine and other type boilers. It replaces the ordinary throttle valve and can be connected on the same pipe flange. It has no moving parts and acts like a stop valve.

MARINE OIL ENGINES.—British Kromhout marine oil engines, their history, and construction and application are detailed in a bulletin issued by Perman and Company, Ltd., London, E. C. 3, England. The engine is of the 2-cycle type and is built in units from 9 to 500 brake horsepower. Numerous illustrations are given of installations in various types of ships.

MARINE SOCIETIES

AMERICA

American Society of Naval Engineers
Navy Department, Washington, D. C.
Secretary-Treasurer—Commander S. M. Robinson, U. S. N., Bureau of Engineering, Navy Department, Washington, D. C.

Society of Naval Architects and Marine Engineers
29 West 39th Street, New York.
Secretary and Treasurer—Daniel H. Cox.

National Asociation of Engine and Boat Manufacturers
29 West 39th Street, New York City.
Secretary—R. R. A. Hand.

United States Naval Institute
Naval Academy, Annapolis, Md.
Secretary and Treasurer—Commander H. K. Hewitt, U. S. N.

American Marine Association
15 Park Row, New York
President—E. A. Simmons.
Secretary—Robert B. Lea.

The New York Tow Boat Exchange
11 Moore St., New York.
Secretary—Irving G. Keller.

Port of New York Authority
11 Broadway, New York.
Chairman—E. H. Outerbridge.
Secretary—William Leary.

Marine Engineers' Supply Men's Association
Room 507, 30 Church Street, New York.
Secretary—Robert P. Jones.

National Association of Masters, Mates and Pilots
National Secretary—M. D. Tenniswood, 308 Vine St., Camden, N. J.

American Society of Marine Designers
Secretary—B. G. Barnes, 202 Kendrick Ave., Quincy, Mass

National Marine Engineers' Beneficial Association
Headquarters 311-315 Machinists Building, Washington, D. C.
Secretary-Treasurer—George A. Grubb.

Atlantic Coast Shipbuilders' Association
1701 Walnut Street, Philadelphia, Pa.
Secretary—C. S. King.

American Steamship Owners' Association
11 Broadway, New York
President—H. H. Raymond.
Vice-President and General Manager—Winthrop I. Marvin.

United States Ship Operators' Association
149 Broadway, New York
President—C. H. Potter

National Merchant Marine Association
Munsey Bldg., Washington, D. C.
President—Hon. J. E. Ransdell.

The Maritime Association of the Port of New York
78 Broad St., New York City
President—Charles H. Potter.
Secretary—Walter F. Firth.

Lake Carriers' Association
Detroit, Mich.
Secretary—George A. Marr.

Neptune Association
21 Pearl St., New York City
Secretary-Treasurer—Captain John F. Milliken.

Ocean Association of Marine Engineers
15 Whitehall St., New York City
Secretary—Bert L. Todd.

CANADA

Grand Council N. A. of M. E. of Canada
Grand Secretary-Treasurer—Neil J. Morrison, Box 886, St. John, N. B.

GREAT BRITAIN

Institution of Naval Architects
5 Adelphi Terrace, London, W. C.

Institution of Engineers and Shipbuilders in Scotland
39 Elmbank Crescent, Glasgow.

Northeast Coast Institution of Engineers and Shipbuilders
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

Institute of Marine Engineers, Incorporated
The Minories, Tower Hill, London.

ITALY

Collegio Degli Ingegneri Naval e Meccanici in Italia

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